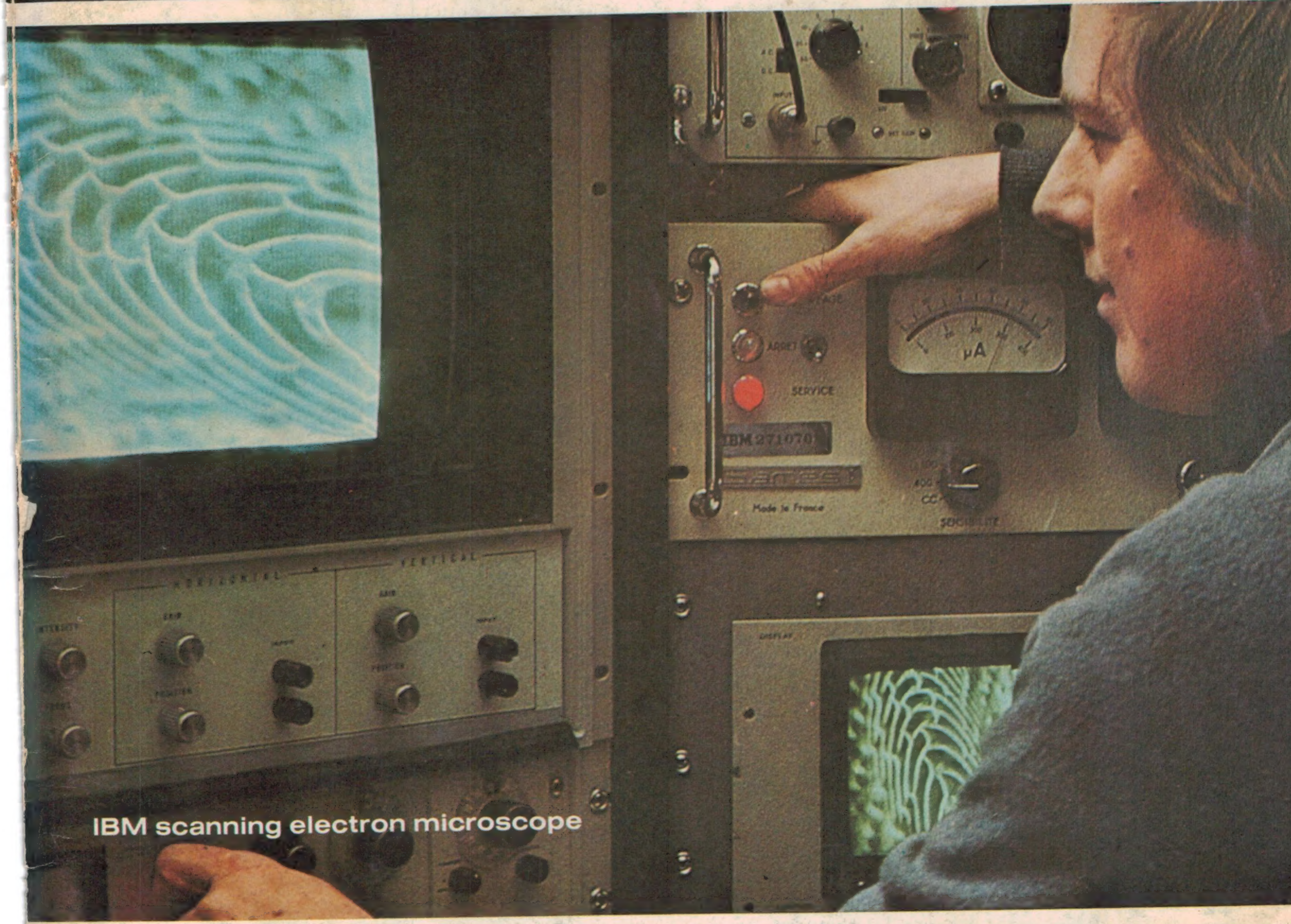
ELECTRONICS Australia

HIFI NEWS

MARCH, 1976
AUST $1.00* NZ $1.00



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The price? $189! Have a listen to the Sony PS2350 – we think you'll agree it's superb.

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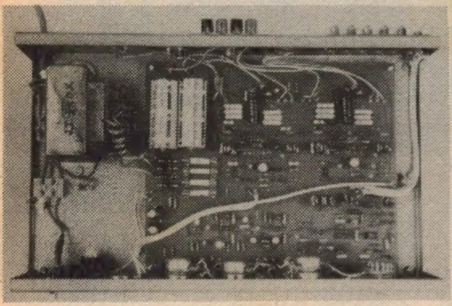
ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 37 No 12

With this issue, we commence description of an easy-to-build, low-cost electronic organ that should suit beginner and enthusiast alike. The basic unit features 4-octave compass, two-speed vibrato of adjustable depth, pitch control, and four stops. Details on page 34.

Coming next month!



Don't miss the next issue in which we feature the first article on the exciting new Playmaster Twin Twentyfive stereo amplifier. It is really easy to build, all on a single PCB and uses readily available parts. Make sure you get your own copy!

On the cover

Electron beam technology has been extensively developed at IBM Corporate Research Division, both to increae the resolving power of electron microscopes and to fabricate ultra-small devices. Shown here is the image produced by a surface scanning microscope whose novel design permits resolution of details 20-30 Angstroms in size, about three times smaller than can be seen with previous instruments. (Photo courtesy IBM Australia.)

CONTENTS—MARCH, 1976

world of electronics and hi-fi

projects and technical

regular features

A screwdriver and about ½ an hour is all you need to build this 40 watt Philips speaker system.

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Editorial Viewpoint

TV programs & advertising—revisited

Some 15 months ago in this column I was critical of the TV programs being broadcast for children, and of the advertising with which they were heavily laced. I also expressed misgivings about the possible long-term effects of this material on the psychological development of our children, pointing out how little we really know as yet about the effects on either children or adults of audio-visual violence, or the emotion manipulating techniques used by advertisers.

Not surprisingly, these comments drew fire from people within the commercial TV and advertising industries. The main point made by the apologists was that I was not qualified to pass judgement upon TV programming or advertising, because I was not an "expert"—i.e., someone working in their industries. When this patently invalid argument was challenged, they fell back on the time-worn excuse that "we only give the public what it wants".

There are so many flaws in this argument that at the time I found it very difficult to believe it was being offered seriously—let alone sincerely. For a start, the rating system used to determine "what the public wants" at best only indicates how the public chose between the limited material which has already been broadcast; it gives no real indication of the material they would appreciate or benefit from in the future, if given a real choice.

Unfortunately despite the weak arguments of the apologists, it soon became clear that critics of the system like myself were simply voices in the wilderness. Nothing seemed likely to be done, and since then I had given up the subject as a lost cause.

It was therefore with great interest and satisfaction that I read the recent report on this same subject by two researchers at the Sydney Teachers College. As I mention in the review of this report on page 114 of this issue, it lends considerable weight to the view that we need to know much more about TV and its effects upon the young mind.

I hope this report meets with the interested reception it deserves-not just from broadcasting authorities, administrators, and researchers in education and sociology, but from those to whom programming and advertising should be of direct concern: parents. I hope also that the points it raises are given careful consideration by the ABCB committee currently looking into revision of the regulations concerning TV programming and advertising.

In the meantime, those who are concerned about programs and advertising can help influence the eventual outcome by acting individually. Not just by the direct method of "channel selector censorship", but also by registering complaints with the stations, the advertisers and the ABCB whenever they see objectionable or suspect material.

If you don't do this, you can hardly complain if nothing much is done.

—Jamieson Rowe

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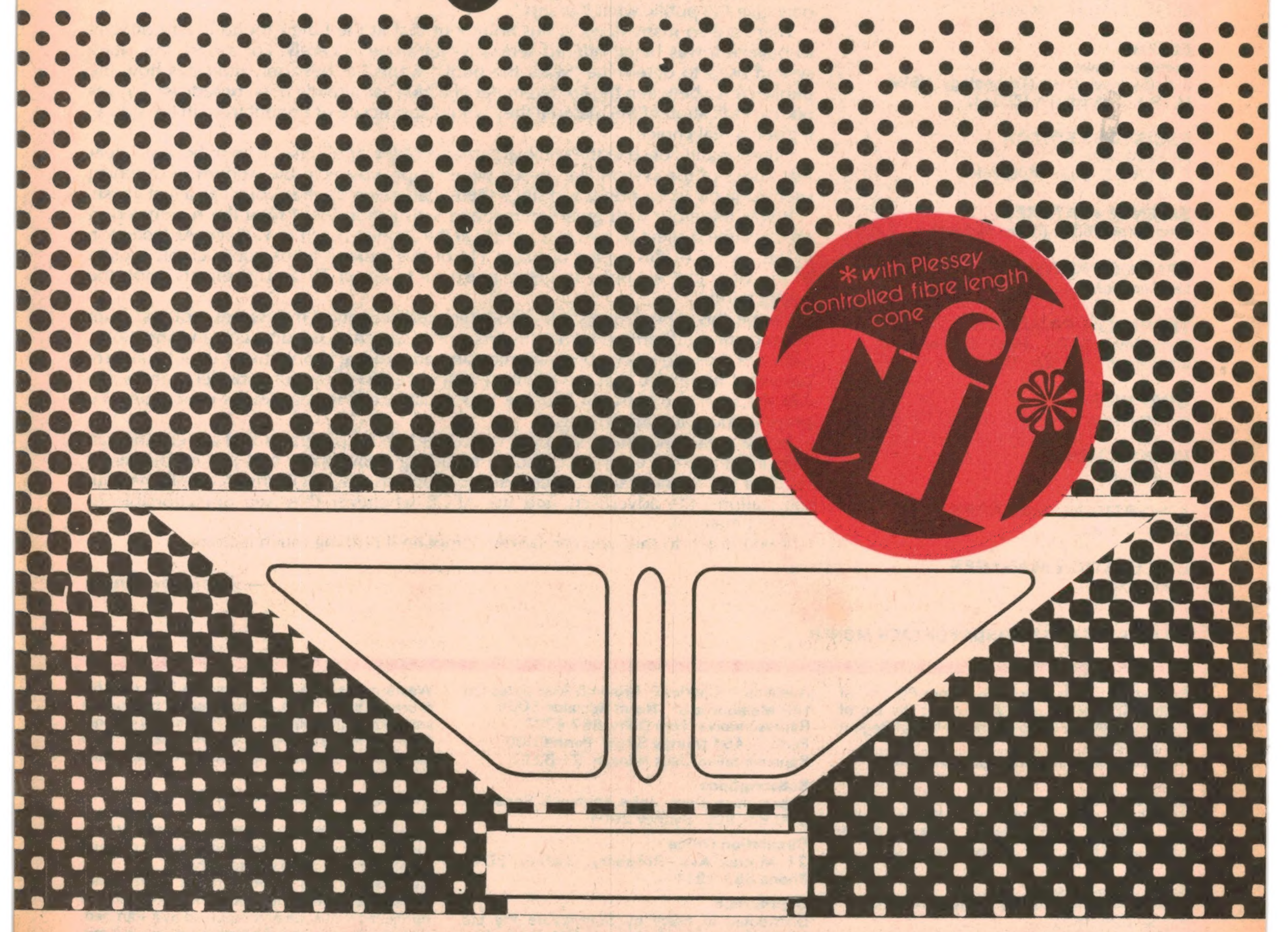

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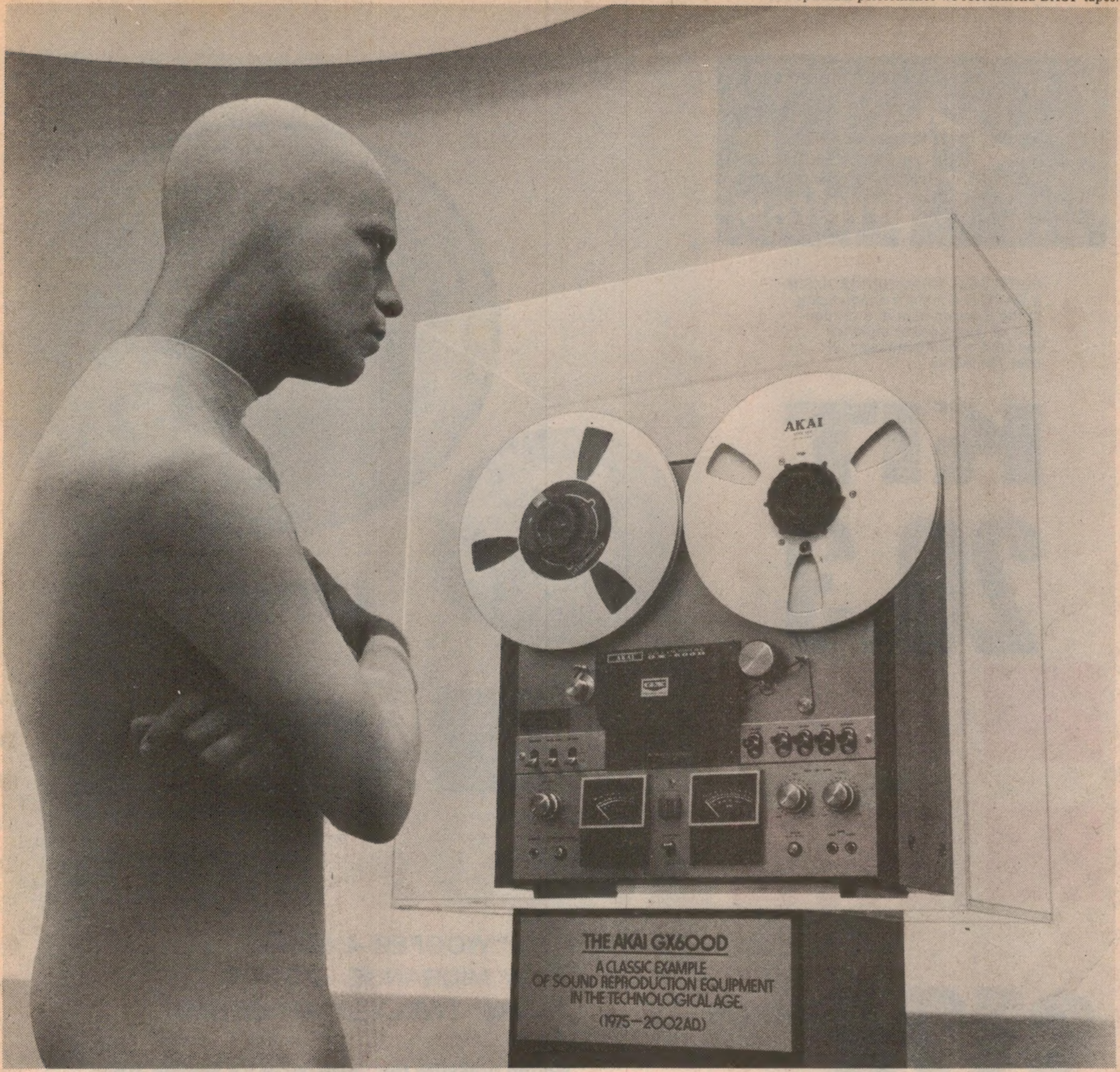
For optimum performance we recommend BASF tapes.



Its rewards might be in another place and time, but yours are here and now.

The GX600D tape deck illustrated above is one of our top models. It retails around $770. That's a lot. But the GX600D is a lot of tape deck. It's totally professional in every function. Recording, dubbing, mixing, playback.

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*The Complete Protection Plan does not cover equipment purchased outside Australia.

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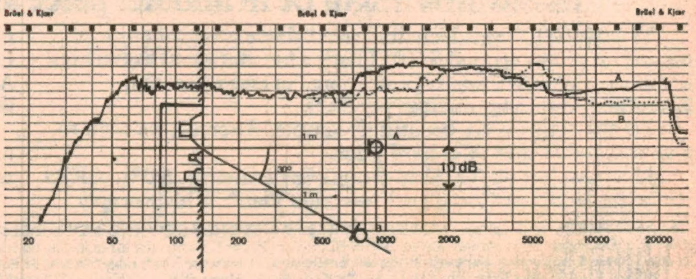
Sound pressure response curve for system 20-3.



CROSSOVER FREQ.	1500 & 6000 CPS
POWER HANDLING	50 WATTS RMS
POWER REQUIREMENT	6 WATTS RMS
FREQ. RESP.	55-20,000 CPS
CABINET SIZE	20 LITRES

Curve A: Axial pressure response frequency characteristic measured as per DIN 45500.
Curve B: Corresponding curve measured 30° from axis (normal listening direction by stereo).

Danish HI FI Southern Cross Plaza 638930 and Burke Road, Camberwell 824839 Melbourne. **Convoy Technocentre** Woolloomooloo 3582088 Sydney. **Danish HI FI** Mount Lawley 710100 Perth. **Brisbane Agencies Audio Centre** Fortitude Valley 219944 Brisbane.

Hi Fi News

A portable radio "that costs the earth..."

The above heading is neither critical of a product, nor is it original. It has been adopted by National Panasonic as a marketing slogan for their latest model the RF-8000: "A portable radio that costs the earth . . . But it gives you the world". At a recommended retail price of $2,700, the first part of the slogan, at least, needs no further justification!

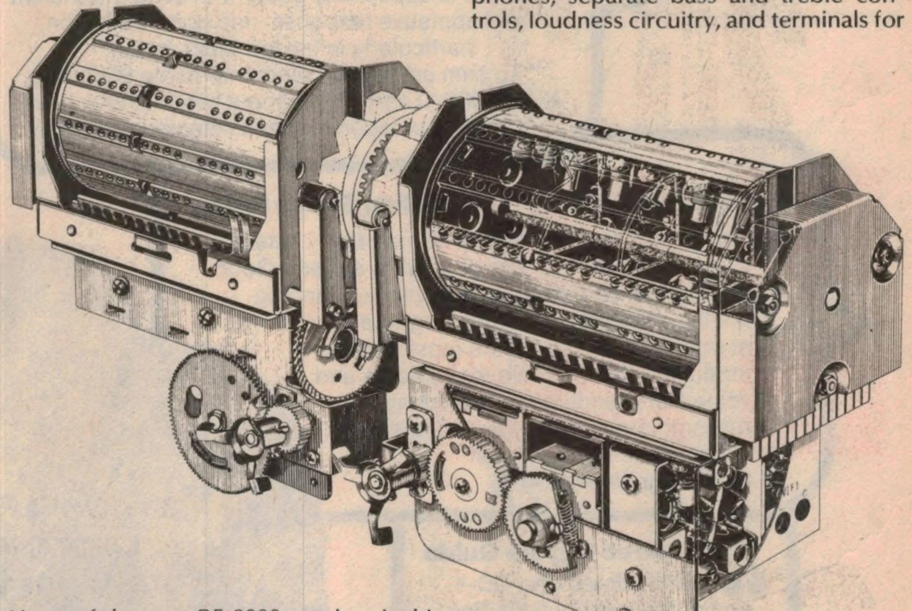
by NEVILLE WILLIAMS

Apart from their hifi products, National Panasonic are well known for their transistor portables, ranging from very small personal compacts to ambitious and expensive multiband portables. But it is safe to say that few enthusiasts will have envisaged or expected anything as pretentious—or as costly—as the new RF-8000.

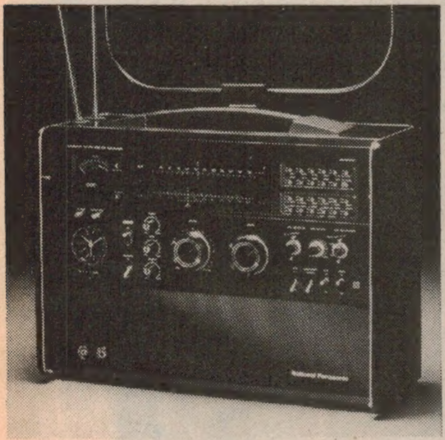
It would surely represent some kind of an ultimate to the DX enthusiast.

Instead of the more usual three or four bands, the RF-8000 offers no less than 24, ranging in coverage from 150kHz to 230MHz, and distributed over two separate tuning dials.

The first group of bands cover long-wave, medium-wave, 8 VHF bands and 2 that are commonly used for marine weather broadcasts. In the second group are 12 short-wave bands, each 1MHz wide, and each with a substantially linear tuning scale. Not only does the receiver cover the various bands, but it can be switched for a variety of modes, AM, FM, SSB and CW. According to the manufacturers, the general performance must be equated, not to portable receivers as such, but to communications style equipment.



Heart of the new RF-8000 receiver is this turret, with integral RF amplifier circuitry.



Early pictures of the RF-8000 convey the impression of just another gimmicky portable. Only later does it become evident that it is possibly the most elaborate and expensive consumer portable radio ever devised!

An in-built crystal calibrator is provided, which allows the dial to be set more precisely so that SW frequencies can be read off to an accuracy of at least 5kHz.

From the point of view of the user, band selection is the easiest yet to operate. The user merely presses the button and waits for a few seconds for the internal mechanism to respond. The digitally controlled system rotates the drums separately, as necessary, and illuminates a LED indicator to show that a particular dial is the one now in operation. Contacts in the turret system are gold-plated.

In the interests of efficiency and best signal/noise ratio, the SW and VHF bands have their own RF amplifier stages, built right into the turret sections.

The bandspread short-wave section uses the well known Collins approach: a double-change superhet, with a separate crystal for each band. This ultimately feeds into a 455kHz IF system with a 10-stage ceramic ladder type filter offering two stages of selectivity, multi-mode reception, amplified AGC, sideband selection, etc.

The VHF section can operate as a single change superhet into a conventional 10.7MHz IF system for wideband FM with AFC and squelch. However, it can be switched through the 455kHz IF system for narrow band operation (60dB down at 15kHz).

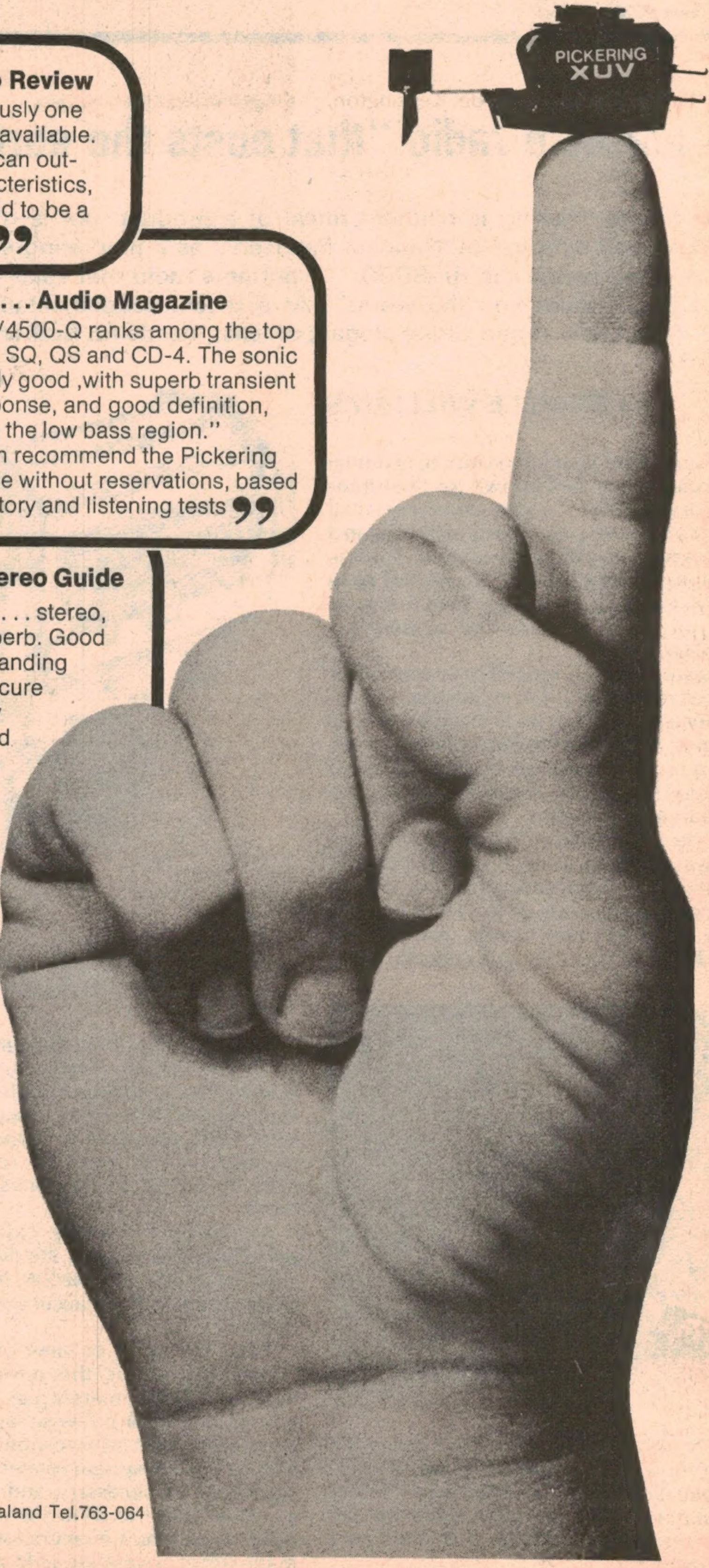
At the output end, the RF-8000 employs a 5-stage wide-range amplifier (50Hz to 20kHz) with provision to drive two built-in 7 x 4in loudspeakers or phones, separate bass and treble controls, loudness circuitry, and terminals for auxiliary input, record output and external loudspeaker.

In keeping with the likely needs of the complete DX enthusiast, the RF-8000 also has its own in-built precision clock, based on a tuning fork and operating from its own 1.5V battery.

For portable use, the receiver operates from 8 "D" size torch cells, giving a nominal output voltage of 12V. However, it can operate from an external DC supply or from AC mains. In the latter case, the supply voltage available to the audio amplifier rises to 16V, with a consequent increase in available power output.

What about antennas? Integral with the receiver are 3 ferrite core antennas, one each for long-wave, medium-wave and marine band. These can be used in conjunction with a rotatable (360-degree) frame antenna for increased indoor directionality and sensitivity. A 2-rod telescopic antenna is provided for

We're #1 — and the critics totally agree!



HIRSCH-HOUCK LABS . . . Stereo Review

"The Pickering XUV/4500-Q is obviously one of the best phono cartridges presently available. There are few stereo cartridges that can outperform it in any of its individual characteristics, and we know of none that could be said to be a better stereo/CD-4 pick-up."

B. V. PISHA . . . Audio Magazine

"The Pickering XUV/4500-Q ranks among the top cartridges for stereo, SQ, QS and CD-4. The sonic clarity is exceptionally good ,with superb transient and applause response, and good definition, particularly in the low bass region."
"To sum up, we can recommend the Pickering XUV/4500-Q cartridge without reservations, based upon our laboratory and listening tests"

MAURICE HOLTHAM . . . Canadian Stereo Guide

"In fact the reproduction of all material . . . stereo, CD-4 and matrix . . . was absolutely superb. Good recordings were reproduced with outstanding fidelity and clarity, and tracking was secure at one gram with even the most heavily modulated bands. Solo instruments and voice were rendered with exciting realism; large orchestral and choral works came through in all their magnificence."

Hi-Fi Stereo Buyers Guide

"In both stereo and CD-4 one of the most outstanding under any program conditions. Sound so clean and crisp it almost hurts."
"This pickup is a perfect example of why measurements cannot truly express the sound quality from a transducer; though the measurements are good, the sound quality was rated by the entire listening panel as superb."

The specifications of the XUV/4500-Q are so exciting that we hope you will write to

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"for those who can hear the difference"

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VHF, while external 75 and 300-ohm antennas can also be connected.

Needless to say, all this does not come in a pocket-size case. The RF-8000 is "portable" in the sense that it can be carried from place to place as a self-contained unit but it measures 512 x 361 x 213mm (just over 20 x 14 x 8in) and weighs 21kg (46+ pounds) without batteries!

Local distributor for National Panasonic is Haco Distributing Agencies Pty Ltd, of 57-69 Anzac Pde, Kensington, NSW 2033. They do not expect to sell large numbers of the RF-8000 in Australia, nor can they afford to have too many of them sitting around on display shelves. But they can supply further details to genuinely interested readers.

TOSHIBA-EMI INTEGRATED STEREO

The new "Stereo Music Centre SM-3200" by Toshiba-EMI combines turntable, cassette player and twin microphones with AM/FM tuner, full preamplifier and power amplifier circuitry and twin loudspeaker systems.

TOSHIBA-EMI

A new integrated stereo system, combining AM/FM stereo radio tuner, preamplifier, power amplifier, turntable deck and a high performance cassette tape deck in one compact unit has been announced by Toshiba-EMI (Australia) Pty Ltd.

Named the Stereo Music Centre SM-3200, the unit is attractively styled in a slim line walnut case with easily located front panel controls.

The radio tuner provides for both VHF FM/stereo and medium-wave AM reception. There is also a long-wave band, but this is of little practical value in Australia. According to manufacturer's literature, "better than average sensitivity and selectivity ratings ensure good quality reception even from distant stations or under crowded channel conditions". The frequency ranges are FM stereo: 88-108MHz, AM: 525-1605kHz (MW) and 150-380kHz (LW).

The SM-3200 may be used with a variety of speakers. Impedances of 4, 8 or 16 ohms can be readily accommodated, and 12 watts RMS per channel is available to provide adequate power for most listening purposes. Separate treble and bass controls are featured and total harmonic distortion is claimed to be no greater than 1.0% at full rated output.

While essentially a two-channel system, a built-in speaker matrix enables the SM-3200 to give four channel effects using an extra pair of speakers. These may also be placed in a separate room and switched (by a front panel pushbutton) to give normal stereo listening from either the main or alternate speakers.

The turntable is a 2-speed semi-automatic unit, using a 4-pole synchronous motor, with belt drive to a die-cast alloy turntable. An S-shaped arm is used, giving inherent dynamic balance, fitted with standard removable headshell, an interchangeable MM-type cartridge and diamond stylus.

A feature of the cassette tape recorder is the Dynamic Noise Limited (DNL) system. Operating only on playback, DNL greatly reduces background tape hiss, and can be switched in or out, as required, by a simple push-button control. Unlike Dolbyised systems with their specific record/playback requirements, DNL can be used on all cassettes — prerecorded or otherwise.

Chromium dioxide tapes and the more usual ferric oxide varieties can be used with the recorder, which is equipped with specially hardened permalloy heads to ensure maximum resistance to wear. The recorder operates at 4.8 cm/sec and has a 4-track/2-channel stereophonic system incorporating individual left and right record level controls.

As well as the usual twin level-meters and three-digit tape counter, the recorder contains a number of additional features including an instantaneous 'pause' control, front-panel microphone sockets and a noise-suppression switch for reducing high frequency noise when recording from radio.

A headphone jack is included on the unit front panel, while connection facilities at the rear include two-channel 'AUX' amplifier input jacks, two-channel 'tape-out' jacks, speaker terminals, and FM and AM antenna jacks. Accessories available include speakers, headphones, microphones, FM antenna and a spindle adapter for 45rpm, 7-inch records. Dimensions of the SM-3200 are 690mm wide x 170mm high x 380mm deep.

Further details are available from Toshiba-EMI (Australia) Pty Ltd, 301 Castlereagh St, Sydney 2000.

Pioneer's new "Monitor 10" headphones feature high sensitivity, often desirable for use with tape decks, preamplifiers, etc. The drivers use mylar diaphragms.

Also designed for high sensitivity, these new Pioneer SE-255 headphones combine performance with economy. Driver diaphragms are carbon fibre blend.

Semi-automatic turntable from Apan

PIONEER HEADPHONES

Two new headphones released by Pioneer Electronics Australia Pty Ltd both offer exceptionally high sensitivity. This sensitivity means that the user can connect them directly to a tape deck, tuner or pre-amplifier and expect high level musical reproduction.

The first of Pioneer's new headphones is the "Monitor 10" and is designed for professional type monitoring of tape recording sessions and the like, or for providing "the ultimate" in private stereo listening.

Pioneer's Marketing Services Manager, Mr Doug Bell says that the Monitor 10 uses a well tested but new polyester material for the large 57mm (2¼") cone drivers. Called mylar, this ultra-thin stiff material helps reproduce crisp tonal differences over the entire frequency range with very low distortion.

Another feature of the Monitor 10 is the unique mounting of the headphone diaphragms, which are housed in specially designed earcups. This prevents any significant leakage of sound radiation.

The other headphones released by Pioneer exploit the advantages of the newly developed speaker cone material called Carbon Fibre Blend.

Commenting on the new SE-255 headphones Mr Bell said: "When translated into performance this space age material enables the speaker cones to produce crisp natural sound reproduction of any part of the frequency spectrum".

Recommended retail prices for the new headphones are approximately $60 for the Monitor 10 and approximately $30 for the SE-255.

For further information: Mr Noel Brown, Pioneer Electronics Aust Pty Ltd, 178-184 Braeside Rd, Braeside, Vic.

Just released in Australia, the Apan Model BRC-233 semi-automatic turntable features belt drive operation, an independent hydraulic cue facility, an S-shaped tone arm with plug-in headshell, and adjustable anti-skating. A magnetic cartridge and the timber base and perspex cover are included in the recommended retail price of $159.00. Further information is available from Ralmar Agencies Pty Ltd, 71-73 Chandos St, St. Leonards, NSW 2065.

CANTATA CASSETTES

By the time this issue appears on sale, a new range of prerecorded cassettes will have made their appearance on the Australian market. Under the "Cantata" label, the cassettes are being produced in Sydney by KGC Laboratories for Convoy International Pty Ltd. They will be distributed to resellers throughout Australia by Goldring Sales and Service Pty Ltd, and can be ordered by local record shops.

Where a supply difficulty is encountered, the cassettes can be obtained — or ordered directly — from Edels Pty Ltd, 437 George St, Sydney 2000.

In discussing the project with an E.A. representative, Malcolm Goldfinch, Convoy's Managing Director, said that the objective was to provide customers with a range of pre-recorded cassettes offering better quality than is normal in the popular field. To this end, the cassettes are recorded on to TDK Dynamic tape, using the Gauss System facilities at KGC Laboratories.

The cassettes are all "Dolbyised" so that, by playing them back on decks switched to "Dolby", a significant improvement in signal/noise ratio will be realised.

Where the playback deck is not fitted with Dolby facilities, there are two options. The first is to turn the treble control down slightly to preserve the best subjective frequency balance, and this will give some discrimination against noise. On the other hand, in a noisy vehicle or environment, the cassette may best be played "straight", in which case the inherent treble boost to low level passages may well make for easier listening.

A group of three of the new Cantata cassettes, typical of the twenty or so titles available as we go to press. We plan to review them progressively through the year. From the currently available titles, Cantata appears to be favouring MOR (middle of road) sound—a description that might be somewhat inappropriate for automotive use!


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Integrated hydraulic cue device. Semi-automatic.
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The top of the range semi-automatic. Strobe edge aluminium turntable. Electronically controlled A.C. servo assisted motor rear mounted. An incredible wow and flutter of 0.08%. Superior Jelco MC 14D cartridge 4 channel ready. For full 4 channel CD 4 sound, change the stylus to Jelco ND-IX or slip in the complete Jelco 4C-IX cartridge.
You can't go past the Apan BRA 121 Series 4000.
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Developing a new recording tape*

by DAVID R. MILLS

Enthusiasts tend to become understandably confused by all the talk of new tape formulations. While this article deals specifically with a new Ampex mastering tape, discussions of the factors involved and decisions that had to be taken parallel those for other tapes aimed at the consumer market.

David Mills, 38, is manager of audio tape development at the Ampex Tape Laboratories in Redwood City, Ca. He holds a degree in chemical engineering from Purdue University and has been involved in research and development in the area of tape recording since 1965. Research on GrandMaster tape has been in train since 1972, paralleling the development of high energy cassette tape.

The goal of any audio mastering system is the faithful recording, storage and reproduction of sound without losing its quality and without adding anything to it. Tape is the storage medium on which magnetization patterns are analogs of the sound—the level of magnetization being proportional to the instantaneous sound intensity.

The limits of a tape's performance are the level of output as a boundary condition on the high side and the level of bias noise as a limit on the low side. The total recording capability of the tape is defined as the region between these limits.

While it is theoretically possible to improve system performance either by increasing the tape's output capability or by reducing the level of tape noise, in a practical sense, the only real option is to increase output while maintaining noise at a low level.

Actual recording equipment is itself somewhat noise limited and, while the system noise of good machines is below the tape noise, it is not so low that a significantly lower noise tape could be used to advantage. In addition, there appears to be no magnetic material currently available which could lower tape noise significantly without creating other performance problems.

To improve the storage medium (tape) without making significant changes in the other elements of the system, it is therefore necessary to increase the tape's capacity for magnetization or, more precisely, its remanence. Also, since the recording process is most effective in the longitudinal direction, it is the longitudinal magnetization which must be increased.

When a significant increase in a tape's capacity for magnetization in the longitudinal direction has been achieved the tape will have the capability to record sound at higher levels without distortion and without a noticeable increase in bias noise. If this is the only change in the tape, the increased output will be realised by increasing the record level; the only other adjustments are those required to recalibrate the meters. Provided the machine is not limited in record current or output handling capacity, the benefits of such a new tape would be immediately apparent on an existing system.

Having reduced the design problem to that of developing a higher output tape to perform in an otherwise fixed system, our next objective was to define the level of improvement which we could realistically expect to achieve. After an analysis of available materials and technology, we set ourselves the following goals (relative to Ampex 406/407):

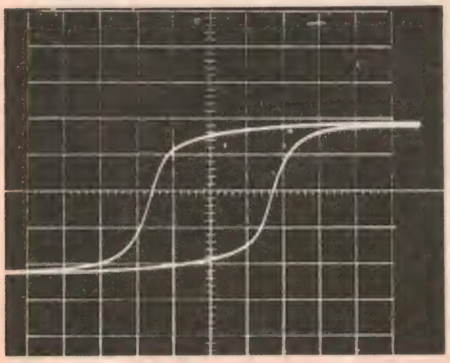
1. A 3 to 4dB improvement in signal-to-noise ratio.
2. No change (increase) in the bias current requirement.
3. No change in the erasure properties
4. No change in equalisation characteristics.

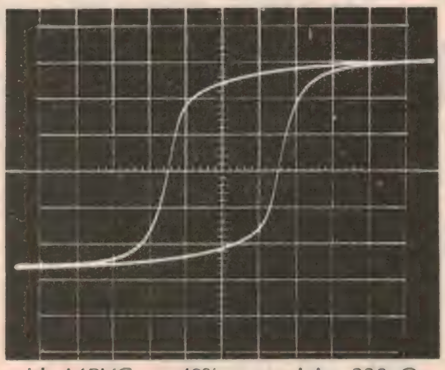
These goals, when translated to the specific magnetic design requirements, meant that we had to accomplish an increase in the magnetic remanence of the tape from a current value of 1100 Gauss to a value exceeding 1500 Gauss. This had to be accomplished without degrading any of the other properties expected in modern recording tapes.

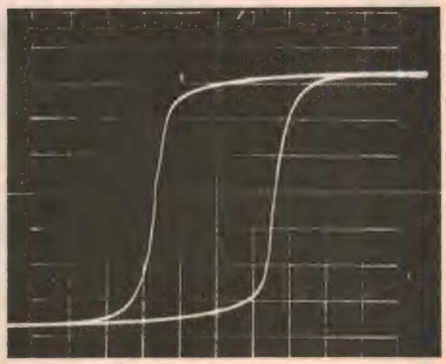
Figs. 1-3 show the evolution of mastering tape through three generations in purely magnetic terms. The hysteresis loop, obtained by subjecting a sample of tape to an oscillating magnetic field and measuring the corresponding change in magnetization, provides a graphic representation of its magnetic recording potential.

The loop is bisected horizontally by the zero magnetization axis and vertically

*By arrangement with Ampex Australia Pty Ltd. Condensed from an article in "Recording Engineer Producer".







These three curves illustrate progress which has been achieved by technological development of the type described in this article. Fig. 1 (left) depicts early mastering tape (circa 1965) with MPVC ca 40%, coercivity 330 Oe, remanence 850 Gs, squareness 0.8 and S/N ratio 66dB. Five years later (Fig. 2) MPVC ca is 50%, coercivity 300 Oe, remanence 1140 Gs, squareness 0.8, S/N 70dB. With the new GrandMaster tape (Fig. 3, right) MPVC ca is 60%, coercivity 325 Oe, remanence 1560 Gs, squareness 0.91, and S/N 74dB. The result: reduced tape distortion at any given output.

METHODS OF INCREASING REMANENCE

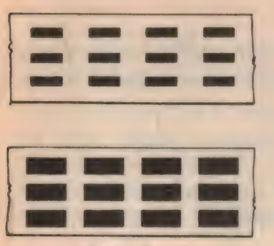


Fig. 4

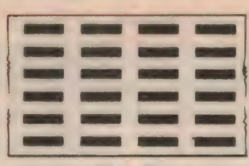


Fig. 5

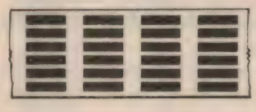


Fig. 6

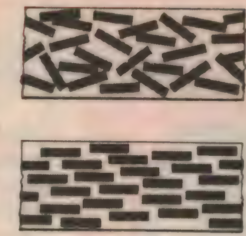


Fig. 7

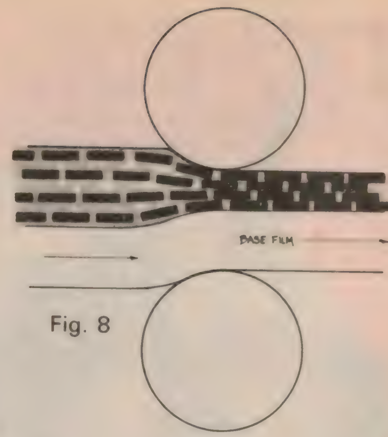


Fig. 8

Assuming the use of a particular type of magnetic coating, the problem of achieving increased remanence is largely a physical one—packing more aligned particles into a coating of acceptable thickness. See text for details.

by the zero field axis. The greater the vertical extension of the loop, the greater the output potential of the tape. The wider the loop, the more difficult it is to magnetize (and demagnetize) the tape.

Specifically, the remanence is defined as the level of magnetization at the point where the loop intersects the vertical axis. The coercivity is the level of field where the loop intersects the horizontal axis.

The coercivity is the field necessary to cause significant magnetization changes and this determines the bias current required for optimum recording and, to some extent, the difficulty of erasure. The objective of our development program was to raise the remanence significantly without making any change in the coercivity.

As Fig. 3 shows, the magnetic formulation finally adopted caused the loop to have high *squareness*—the hysteresis loop is extremely rectangular. This gives higher remanence by virtue of better loop shape, but it has the additional effect of reducing tape distortion at any given output and reducing the difficulty of erasure.

In short, the three curves show the progress, magnetically, from the original mastering tapes to the "state-of-the-art" GrandMaster. Remanence and then squareness were greatly increased while coercivity was held constant to maintain machine compatibility.

Getting back to fundamentals, the remanence of a tape can be increased in the following ways:

1. Use a magnetic material which has a higher intrinsic magnetization than iron oxide. (Fig. 4).

2. Increase the thickness of the coating—increase amount of magnetic material (Fig. 5).

3. Pack more magnetic material into a given tape coating—increase proportion of magnetic material (Fig. 6).

4. Increase the amount of magnetic material which is aligned in the preferred direction—increase orientation (Fig. 7).

Although these four methods are all valid, only the last two could be considered in this case.

The use of material with higher intrinsic magnetization was ruled out because the bias currents required for the known materials having higher magnetization are beyond the capability of existing studio machines. The two materials which can be considered in this case, chromium dioxide (CrO_2), and magnetite (Fe_3O_4), offer only modest improvements in intrinsic magnetization (12-15%) accompanied by serious deficiencies in either chemical stability, coercivity (high bias) and/or cost.

Increasing the magnetic coating thickness provides higher remanence potential because more magnetic oxide is present in the vicinity of the head at any given instant. However, the standard reel configurations make it impossible to increase the oxide thickness significantly without also either reducing the length of the tape or decreasing the base film thickness.

Any reduction in base film thickness would be accompanied by a decrease in the physical strength of the tape and by an increase in the susceptibility to print-through.

The shortening of the standard tape lengths is not desirable, although situations could be envisioned where this approach could be used. Problems might be encountered, however, in ensuring flat response at high frequency if the coating were too thick.

REMANENT MAGNETIZATION: The two techniques which we utilized for increasing the remanent magnetization capability of the new tape were to increase the volumetric loading of magnetic material in the coating (without increasing thickness) and to increase the level of particle orientation in the longitudinal direction. Increased volumetric loading can be achieved in two ways:

1. Formulate the coating so that the magnetic material is a larger fraction of the total coating layer. In the formulator's terminology, this means increasing the

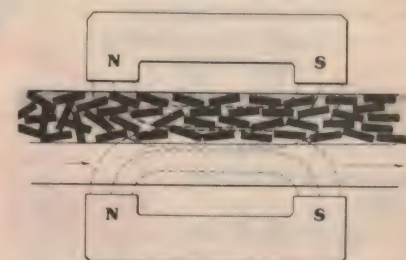


Fig. 11

WAYS TO IMPROVE PARTICLE ORIENTATION

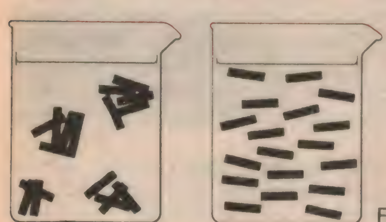


Fig. 9

Adequate particle orientation starts with the mix (Fig. 9 above) but involves application, the use of a magnetic field and the choice of orientable particles.

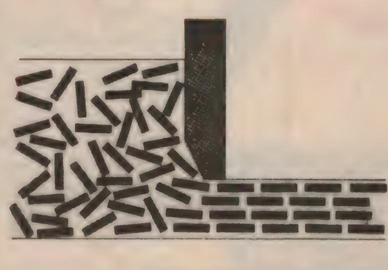


Fig. 10

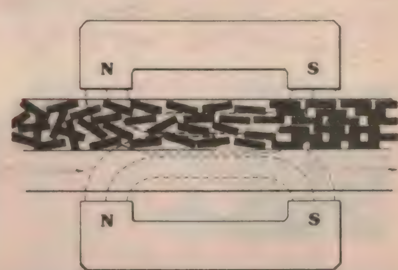


Fig. 12

A new recording tape

magnetic pigment volume concentration (MPVC). In the case of the new tape, the MPVC was increased by about 10%.

In order to do this, the binder system, which is the matrix that contains and supports the magnetic oxide, must be strengthened and improved. If this is not done, serious problems of coating durability will develop, giving rise to oxide shed and head clogging, as well as storage stability problems.

Early binder systems (ca. 1965-1970) were capable of MPVC's in the 35 to 40% range. The class of binders used in the current generation products is capable of MPVC's from 45 to 50%, primarily through the use of cross-linking binder components.

The Grandmaster product achieves its further increase in MPVC to the 55 to 60% range by improvements in basic binder properties and through the reduction of additives which contribute neither magnetic nor binder properties to the coating. As an example, the use of a conductive carbon back coating on the tape permits additional magnetic oxide to be put in the magnetic coating since the carbon, which would otherwise have occupied 4 to 8% of the oxide volume, is relocated to the back of the tape.

2. Increase the density of the oxide coating by high-pressure calendering (Fig. 8). Although the coating is formulated to provide a certain theoretical oxide density, the actual coating contains microscopic voids which cause the magnetic density to be lower than this theoretical value. If the dried but uncured coating is passed between a steel roll and a hard, yet compliant roll at high temperature and pressure, a significant densification/thickness reduction takes place which essentially eliminates the coating voids. This permits the application of initial coating thicknesses which would exceed the full-reel limits at the standard length specifications and then employs hard calendering to compact the coating to obtain correct total tape thickness.

PARTICLE ORIENTATION: Improved particle orientation can be obtained in several ways:

1. Proper dispersion of oxide in the binder system (Fig. 9).
2. Proper adjustment of the rheological characteristics of the fluid coating during application—flow orientation (Fig. 10).
3. Passing the coated tape through an appropriate longitudinal magnetic field while the coating is in the fluid state (Fig. 11).
4. Utilization of a "highly-orientable" magnetic oxide particle in the formulation—HOP (Fig. 12).

It can be assumed that all commercially available tapes have undergone an optimization phase in which Item 1 through 3 have been carefully established to give maximum tape performance. However, until recently there were no gamma ferric particles which could be said to fall in the highly-orientable category. Now there are several.

By selecting an HOP material, it is possible to increase hysterisis loop squareness (a measure of magnetic orientation) from a typical value of 0.80 to values in excess of 0.90. This has a direct effect on the output sensitivity of a tape but it has an even more significant effect on its distortion properties. This is an improvement which manifests itself as a reduction in third harmonic distortion at any operating level. It permits higher recording levels and lower distortion on the tape at any given recorded level. Ultimately, it extends the useful operating range of the tape since it is the onset of distortion and not the absolute saturation point of a tape which defines its limit of usable output.

This is shown in the accompanying input-output curves which clearly reflect the improved linearity and increased output at low and high frequencies of Grandmaster compared with 406/407 (Fig. 13). The farther the output curve follows the 45° line, the lower the distortion characteristics of the tape. Also, the higher maximum values result in greater tape headroom or saturation capability.

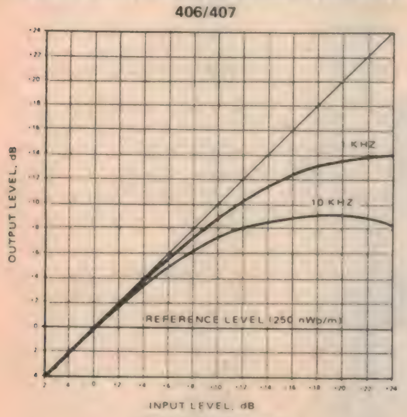
ELECTRICAL PERFORMANCE: The design objective in developing this new tape has necessarily been oversimplified but, in fact, many properties were carefully balanced in arriving at the final product. Two sets of curves (Fig. 14) show the complete audio recording characteristics of the two generations of mastering tape. The curves depict six recording parameters which change with bias current.

Note that on both tapes, the output sensitivity at low and high frequency reaches a maximum at a given bias setting and falls off at lower or higher settings. Also note that the third harmonic distortion reaches a minimum on both tapes at another bias point and increases if the bias setting is raised or lowered. Weighted noise remains relatively constant with bias on both tapes.

The optimum bias setting is a compromise which balances highest output against lowest distortion and flattest response. The choice, for both tapes, is the point at which the distortion is at its minimum and the output is 1.0dB below its peak at 10kHz. This optimum point is exactly the same for both tapes and can be arrived at by overbiasing 1.0dB at 10kHz. Close comparison of the two sets of curves shows the improvements realized in this new tape — increased sensitivity throughout the audio frequencies, low distortion and slightly reduced noise.

INPUT-OUTPUT CHARACTERISTICS

406/407



GRAND MASTER

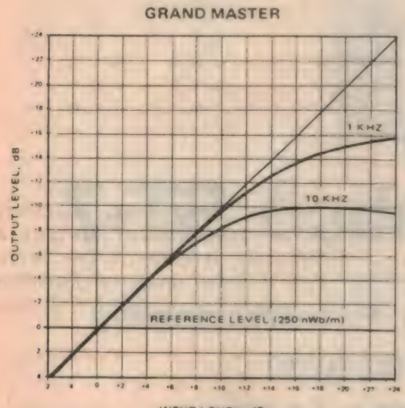


Fig. 13: Reflecting the result of the work described by the author, the lower curve for GrandMaster tape offers a significant improvement over the earlier 406/407 generation.

EFFECT OF BIAS ON RECORDING PARAMETERS

406/407 **GRAND MASTER**

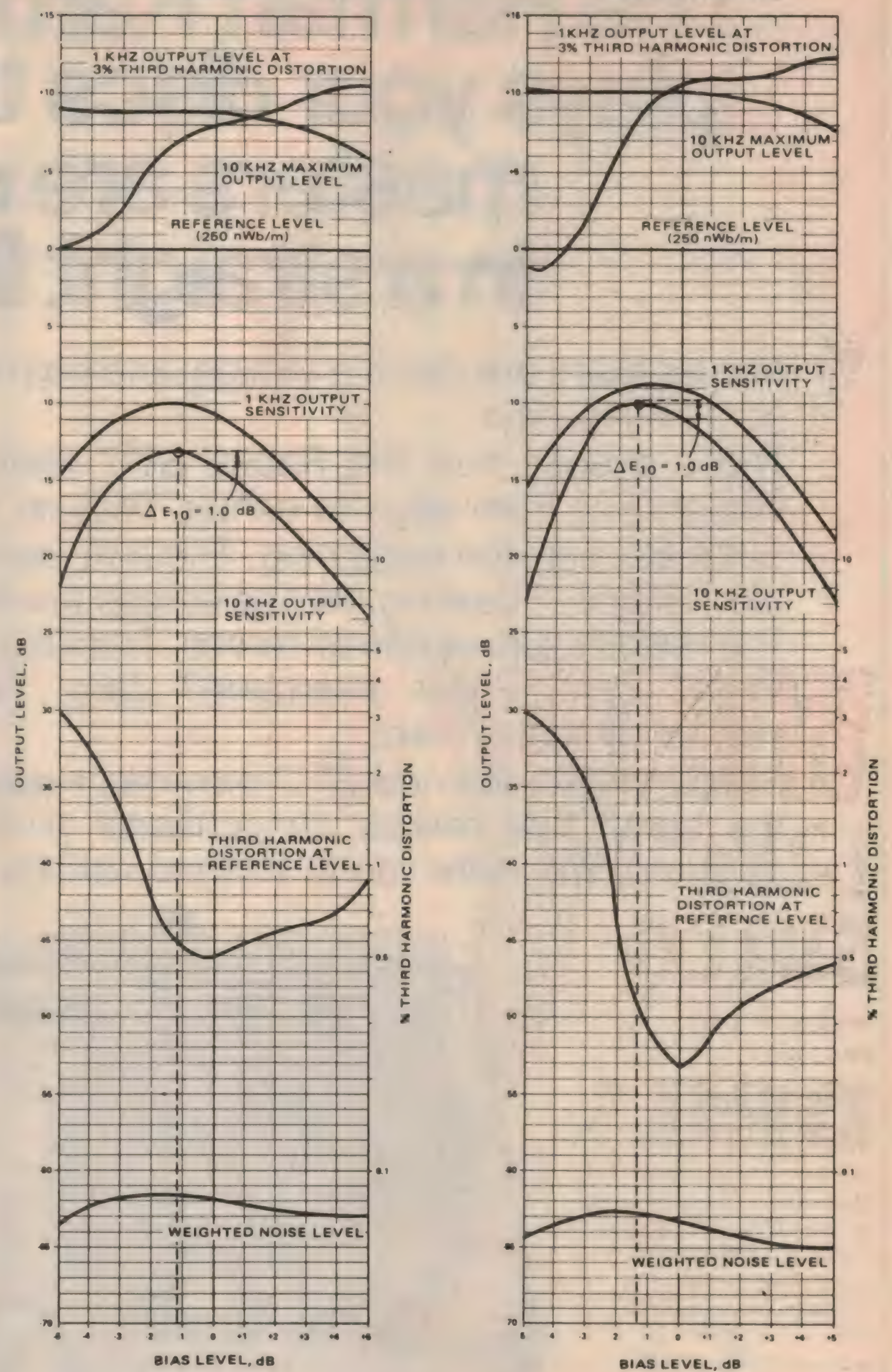


Fig. 14: These two sets of curves indicate the complete audio recording characteristics of two tape generations. Optimum HF bias remains unchanged but every individual performance area shows some improvement.

MACHINE ADJUSTMENT: The result of this development is a tape which can provide 4.0dB of increase in signal-to-noise ratio if used properly. Assuming that a machine is set correctly for the current generation of mastering tape (specifically Ampex 406), the following changes should be made:

1. Increase record level 2.0dB. This increased input level plus the increased sensitivity gives a level on the tape which is 3.0dB higher than 406.
2. Reduce reproduce level 3.0dB to adjust for the higher level on the tape. Because of the improved distortion properties of the tape, this higher level on the tape will have the same third harmonic distortion as 406 did at a level 3.0dB below this point.

Now, without having changed bias, the new tape is being recorded at the same distortion level as before but the apparent noise on playback is 4.0dB lower than with 406 due to its 1.0dB lower intrinsic noise and the 3.0dB lower playback gain.

Yamaha TC-800GL stereo cassette deck

Much of today's high fidelity equipment looks very similar in appearance to the layman, but that problem does not occur with the Yamaha TC-800GL. It was conceived and styled by an Italian industrial designer, Mario Bellini whose signature appears on the control panel.

Whether or not the styling of the Yamaha TC-800GL attracts or repels you, it does have a number of advantages such as excellent visibility. The angled control deck can be easily viewed from any angle in the listening room. And the cascade of controls from top to bottom has a certain compelling logic. But the appearance is in no way related to the other products in the Yamaha high fidelity range.

And for those who cannot understand how a cassette deck can have its weight-distribution so arranged that it will sit in that slanted mode, we can now reveal the truth. The deck has a fold-out prop on its underside, to stop it from reverting to the horizontal position of its forebears!

The case is all plastic, with a charcoal coloured velvety scuff-resistant finish. The finish does not show finger-marks and is a good background for the screen-printed lettering of the various labels and controls. The underside of the deck has a compartment to accommodate nine C-size flashlight cells to render the unit free of mains-power. The deck may also be powered from a car battery.

Six rocker buttons are used to control the transport mechanism. These have a slightly different layout from that on most cassette decks, although this does not seem to pose any difficulties. The buttons have a fairly heavy action which can be a problem for those who are not heavy-handed.

No less than seven slider controls are featured in the cascading display. At the top is the pitch control which has a detent position in the centre of its travel to provide the correct speed. Range of speed control is about plus and minus 3% so the calibrations to plus and minus 5 are perhaps a little inappropriate.

Below the pitch control are individual sliders for playback level, and microphone and line mixing. We found that the slider controls did not have a pleasant feel when being operated and the serrations on the slider "pads" were too sharp and rough for comfort. One good point though – Yamaha have taken pains to ensure that the slider elements are well sealed against dust and dirt. Overall travel of the sliders is 45mm.

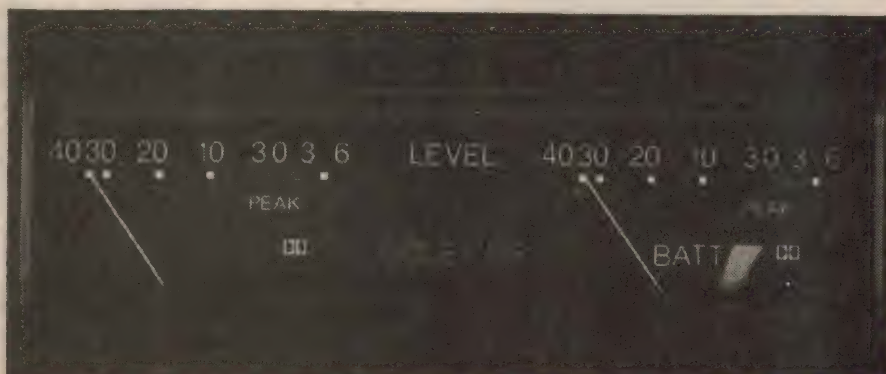
Five push-buttons are provided above the slider controls for Memory, Limiter, Dolby NR, FeCr and Power. The Memory feature is the same as on other cassette decks in that it allows a cassette to be rewound to a preset "000" setting on the revolution counter whereupon the mechanism stops automatically. The Limiter is also similar to other decks in that it acts to compress recording levels when they rise above OdB. The Limiter has low distortion and Fast attack and slow decay times.

Readers will note that there is a button to provide optimum conditions for the new Ferrichrome tape but Cr02 does not seem to be mentioned. This is because the TC-800GL is one of the few cassette decks available which automatically senses the presence of a Cr02 cassette and change the necessary circuits for optimum conditions.

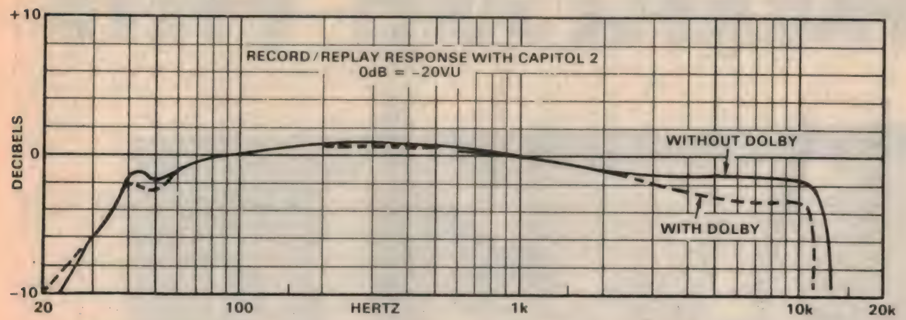
The metering facilities are unusually comprehensive. Notice that the meters are calibrated over a range of 46dB– from minus 40 to plus 6. Most cassette decks only design to provide meters with half that range, and often the calibrations mean very little. However, the meter calibrations on the TC-800GL are notable for their accuracy as well as their range.

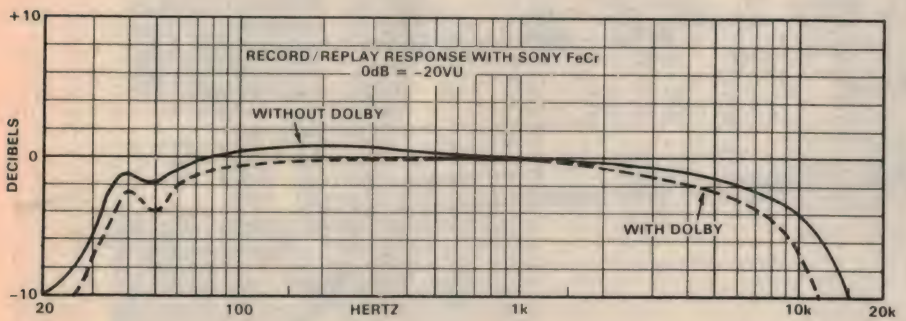
In addition, there are no less than four LEDs, two per meter to give further indication of signal conditions. Red LEDs are used to indicate peaks in excess of 0VU while green LEDs (which may not be visible in our illustration) start to glow at minus 7dB below 0VU and are fully alight at minus 3dB. Thus by following the manual instructions on the use of the meters and LEDs it is possible to obtain near-optimum recording levels.

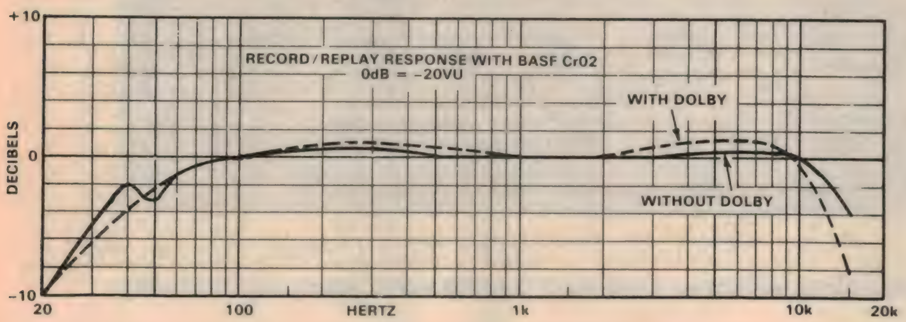
The underside of the case is removable to reveal an interior that is crowded with circuitry, as is the case with most



Notice that the meters are calibrated from minus 40 to plus 6.







cassette decks. Several integrated circuits are employed. For example, the microphone input preamplifiers are low noise ICs, as are the meter and LED drive circuits. The Dolby circuitry also uses an IC, the NE545B manufactured by National Semiconductors. Changes to bias, metering and equalisation circuitry to accommodate the different tape types is accomplished by switching transistors rather than a large multi-contact switch.

The unit reviewed had a removeable two-core mains flex fitted with a two-pin plug. Since other Yamaha equipment is supplied with the correct mains cord and plug we assume that the local distributor will at least fit a three-pin mains plug.

The biggest problem we found with the deck was that of loading and unloading cassettes. We found cassettes difficult to load – pushing the cassette into the carrier clicked it into place, but spring tension pushed it out slightly so that the cassette fouled the locating pins when the lid carrier was closed. And when the Eject button was pushed, the deck unerringly fired the cassette onto the floor. This was probably due to maladjustment as it seemed to worsen as our tests proceeded.

Frequency response test results are shown in the accompanying graphs. These are taken at the usual level of minus 20dB below 0VU are quite typical of many cassette decks in this price range. As is usually the case, the frequency response was not quite as extended nor as linear when Dolby noise reduction was employed.

Harmonic distortion is quite low even at levels well above 0VU and typical measurements yielded results of the order of 1%. Signal-to-noise ratio was 50dB which improved to 52dB with Dolby in use although this measurement does not take into account the normal attenuation above 5kHz so the audible result is rather better than the results indicate.

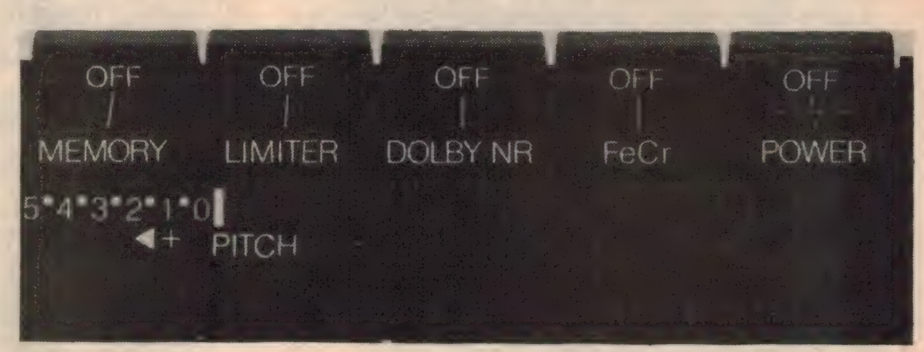
Clearly Yamaha could have improved frequency response and signal-to-noise ratios but this would mean a worsening of the harmonic distortion figures. We rate the specifications compromise as being a good one, and indicative of conservative design rather than "spec chasing".

Separation between channels was very good and ranged from better than 40dB at 100Hz and 1kHz to better than 30dB at 10kHz. Meter response was also very good with the minus 3dB indication at 16kHz.

Very low figures are claimed for wow and flutter performance but we found it quite dependent on the vagaries of cassettes. We were able to obtain a best measurement of 0.13% DIN, which is very good although this result could not be expected with most cassettes.

Sound quality on playback was generally good although not up to the ultimate standards set by some very expensive decks on the market. During headphone listening we noted that hum was audible during quiet passages but this did not occur on playback via an amplifier and loudspeakers.

In summation, we must rate the Yamaha TC-800GL as being a good all-round performer with must unusual styling and features, some of which space prevents us from detailing. In view of its performance and features, the price is not unreasonable in these times of generally inflated prices.



No switch is provided for Cr02 cassettes as these are sensed automatically.

Recommended retail price of the Yamaha TC-800GL is $398 including sales tax. Further information may be obtained from hifi retailers or from the Australian distributors, Rose Music Pty Ltd, 17-23 Market Street, South Melbourne or interstate offices. (L.D.S.)

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Sony ST-4950 FM Tuner

One of the trends with FM tuners is to package them in larger chassis, larger in fact than many stereo amplifiers. Here is one of the new models from Sony, the ST-4950, which matches the new range of V-Fet stereo amplifiers.

Dimensions of the Sony ST-4950 are 462 x 331 x 168mm (W x H x D) including knobs, rear terminals and feet. An extra 150mm is required at the rear of the chassis to enable the bar antenna to be swung through a maximum arc of 90 degrees for best AM reception. Mass of the unit is 8.6kg.

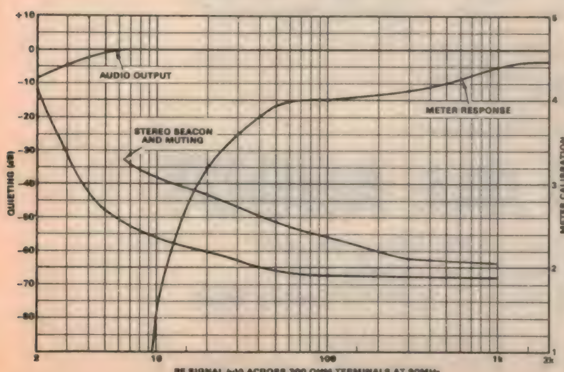
Size and styling of the unit combine to give an impression of sizeable mass. Two meters are employed, one for AM and FM signal strength while the other is a centre-indicating type for FM tuning accuracy. A long linear tuning scale combined with the large fly-wheel assisted tuning knob makes tuning very easy. A red LED doubles the visible length of the dial pointer when a station is tuned in, so that combined with the meter indications there is no mistaking stations when tuning across the dial. Dial calibrations are very accurate, to within better than 50kHz.

There is a large push-button for Power and three smaller buttons for AFC, Hi-blend and Multipath. The AFC button is normally deactivated when station tuning but in practice with the ST-4950 it does not really matter. The AFC does not have the tenacious action found on some tuners, whereby the pointer can be moved half-way across the dial before the AFC finally "lets go" of a strong station with all the reluctance of a cow pulling its foot out of a bog.

The Hi-blend button is the same as found on other tuners and is used to reduce high frequency noise on weak stereo signals. It effects a slight reduction in the high frequency response and a quite drastic reduction in separation between channels at high frequencies.

A three-position Function switch provides FM stereo, FM mono and AM reception modes. Terminals are provided on the rear panel for 75 ohm coaxial cable and 300 ohm ribbon antennas as well as a long-wire AM antenna which is used where the bar antenna does not suffice. RCA sockets are provided for fixed and variable audio outputs and the mono output from the discriminator. In addition, there are two screwdriver preset controls for the variable audio output levels.

Sony fit a detachable three-core power flex fitted with the correct three-pin mains plug for the Australian market. The fact that the chassis and one side of the signal circuitry are tied to mains earth results in an earth loop problem for some amplifiers, but there was no problem with a companion Sony TA-5650 V-Fet stereo amplifier which we had on test at the same time. (This amplifier will be reviewed next month.)



At left are the quieting characteristics for the ST-4950. Also included is the meter response versus signal strength.

path display on an oscilloscope. However, the multipath button on the front panel is more useful as far as most listeners are concerned. When this button is depressed in the presence of multipath reception conditions the signal-strength meter responds to the audio amplitude of the audio signal. The instruction manual clearly indicates how the signal strength should be maximised while minimising multipath reception by careful antenna orientation. With this procedure it is a straightforward task to obtain the most distortion-free FM reception.

As can be seen from the photograph of the interior, most of the circuitry is accommodated on a large PC board which, at 385mm wide, is one of the largest we have seen in a high fidelity component. A six-section tuning gang is mounted on the FM front-end PC board. Two sections

AMPLIFIERS EXPLAINED:

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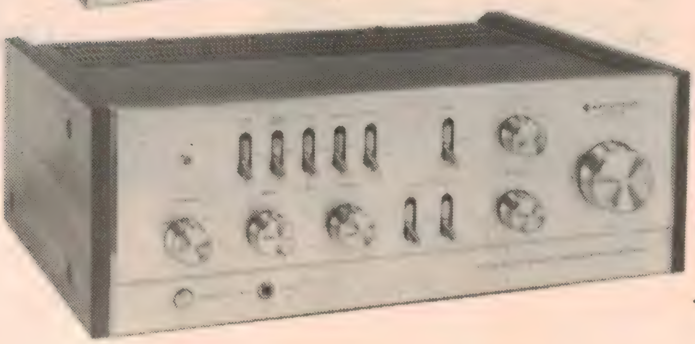
$285.00*



KA-4006**
Power Output: 32 + 32 watts RMS into 8 ohms load at 20 Hz-20,000 Hz. Both channels driven. Total Harmonic Distortion: 0.5% at rated power into 8 ohms load. Power Bandwidth: 8 Hz to 45,000 Hz.
$399.00*

*Recommended Retail Price.
**Averaged manufacturers' specifications subject to change without notice.

The amplifier is the heart of a hi-fi system. It takes the electronic signals from your programme source and boosts them sufficiently to enable the speaker to convert them to actual sound. The amplifiers above are examples of good amplifiers. They aren't cheap, but nor is any good hi-fi component. Their specifications are their credentials. If you understand them, you'll know just how good they are. If you're a bit lost with the specifications, we have just the thing: "The New, Improved, Updated, More Detailed Hi-Fi Explained in Simple Language by Kenwood Booklet". It will make these specifications much clearer. Because when you know more about good hi-fi, you'll be better able to appreciate Kenwood hi-fi.

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are used for the mixer and local oscillator of the AM tuner circuitry.

Integrated circuits are used for the IF amplifiers and the multiplex decoder while the remainder of the circuitry employs discrete semiconductors. Total semiconductor count is 3 IC's, 4 FETs, 23 transistors and 20 diodes and two LEDs.

Most of the performance specifications are summarised in the two graphs. These curves are for 100% audio modulation and pilot level of 10%. The meter response to signal strength is very non-linear and is virtually saturated (at a reading of about 4.5) for signals of 1mV or so.

Frequency response is within ±1dB from 20Hz to 15kHz and separation between channels was also very good: approaching 40dB over most of the audio range. Suppression of 19kHz and 38kHz residual signals was excellent at 62dB. Ultimate quieting level was 68dB, which is also the residual noise level in the muted condition.

Harmonic distortion was not quite as good as the specification with readings of just over 0.2% in mono mode and .33%, 0.3% and .37% in stereo at 100Hz, 1kHz and 6kHz respectively.

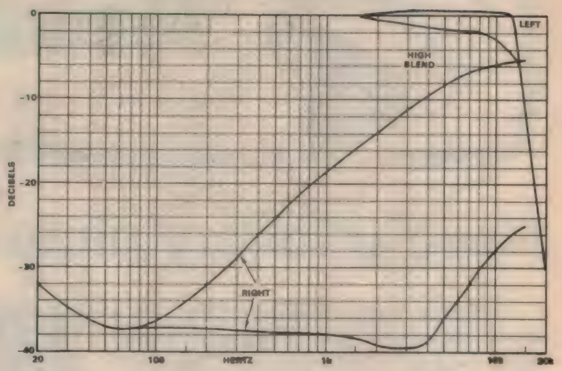
While the overall performance in the FM mono and stereo modes is undeniably good, the AM performance is lamentable. For example the audio bandwidth is only of the order of 2kHz. One can obtain better from a $10 portable! How manufacturers can continue to provide such woeful AM performance at such prices is hard to credit. It is akin to selling a colour TV receiver that only receives one channel in colour and the rest in B & W!

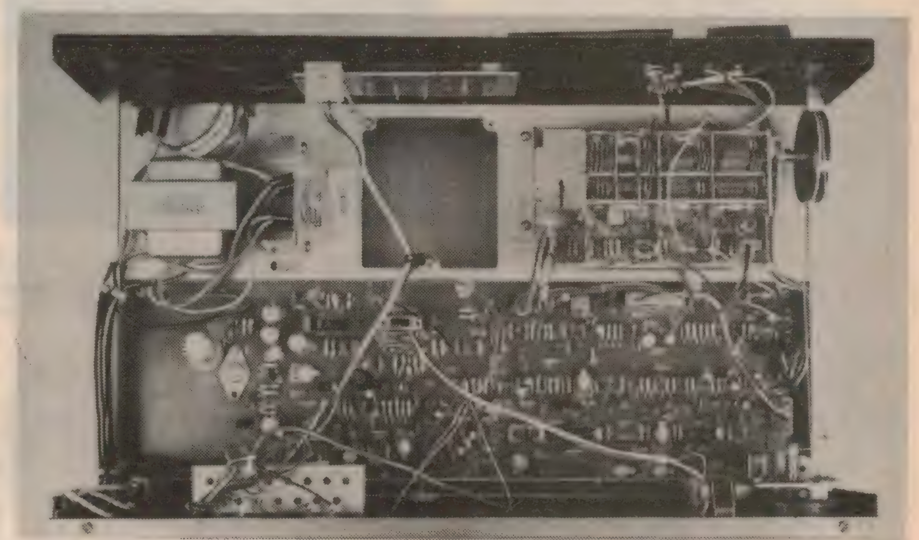
It would seem that if manufacturers are not willing to accept the challenge of designing an AM section of reasonable performance, then they should omit the facility altogether. This is a general criticism applied to all manufacturers, of course. And it is not sufficient to reply that AM programs do not warrant high quality reception. If overseas journals are correct, it would appear that many FM stations overseas are content with low standards anyway and that there are many high-quality AM stations. Why not make the effort to obtain good reception from both?

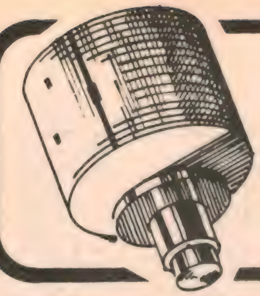
Aside from our major criticism regarding AM reception, it is difficult to fault the ST-4950. It is clearly well-designed and assembled meticulously.

Recommended retail price of the Sony ST-4950 is $389 including sales tax. Further information can be obtained from high fidelity retailers or from the Australian distributors, Sony Kemtron Pty Ltd, 453 Kent Street, Sydney, NSW 2000. (L.D.S.)

These curves show the frequency response and separation between channels and shows the effect of the Hi-blend switch.







News Highlights

Revolutionary picture transmission system

A picture transmission system and a new visual display system, both described as "revolutionary", have been developed at the University of Western Australia. The inventors, Professor John Ross (psychology) and computer technologist Monte Sala, developed the new systems out of fundamental research being carried out by Professor Ross and his colleagues on the human eye and visual perception.

The new picture transmission system enables rapid transmission of photographs, maps and other graphic material by cable or by radio. In terms of cost, speed, reliability and resistance to interference, the system is believed to be vastly superior to any presently available. It is also claimed to provide the first "natural" means of computer picture storage.

The conventional method of transmitting a picture is to send it as a frame broken down into a series of lines. Transmission starts at the top left hand corner of the frame and continues line by line until the picture is completed at the bottom right hand corner. The system devised by Professor Ross and Mr Sala differs in that random scan patterns are used to convey the information.

For purposes of transmission, the picture is broken down into thousands of individual picture elements which are transmitted one by one in a random sequence. An addressing system, devised by Mr Sala, defines the location of each element within the picture. The inventors claim that each picture element is addressed at a cost of one bit of information per element.

At the receiving end, the picture elements are re-assembled by detecting the address bits, determining the correct location for each picture element, and locating it accordingly. In interference-free conditions, the prototype machine will receive a picture over a voice-quality channel in less than 3 seconds.

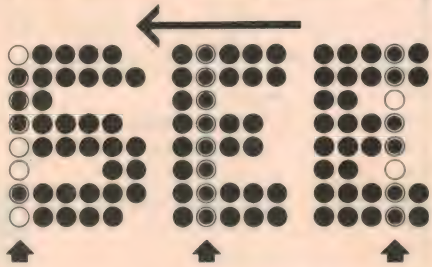
The new technique has several inherent advantages over more conventional transmission techniques. In particular, it offers greater immunity to interference. Interference to the signal train will only affect individual picture elements, and because these will be randomly distributed in the picture the effects will be less noticeable to the observer.

Photograph at left shows image of Professor Ross 'coming up' on the screen, while at right is the final picture. Although the developmental system displays identification quality half tones, high quality transmission is feasible.

Other features are the ability to transmit at variable speeds, and the capacity of the receiver to start building the picture from any point. And because the system is inherently digital, pictures may be stored by computer on any convenient mass storage device.

The new visual display system, known as the Betagraph, utilises a remarkable capacity of the human visual system recently discovered by Professor Ross. This capacity is used in the Betagraph to cause the viewer to see a picture which is not objectively present.

By way of analogy, the principle of the Betagraph can be illustrated by considering a car moving behind a picket fence. While it has long been appreciated that the image which the eye sees is based on scanty information, namely the pattern of light and colour appearing through the cracks between the pickets, it is now known that the eye's ability to construct a picture of the car is very highly developed.



Solid circles represent the Betagraph image. Only the solid circles enclosed by line circles are actually objectively present as lights 'on', the open circles representing lights 'off'. A suitably programmed pattern of lights in the columns indicated by the arrows causes the image to move across the entire visual field.

In the Betagraph, the display consists of widely spaced columns of LEDs which may be considered as corresponding to the cracks in the fence. When these LEDs are turned on and off in appropriate sequences, the eye sees, not vertical columns of dancing light, but a moving image which appears to fill the space between the light columns.

The material displayed may consist of text and pictures, and messages may be as long as required. Movement may be in either direction. The display can be computer controlled as part of a network, or can be driven from a standard cassette recorder.

The great advantage of the Betagraph is the small number of light sources required in comparison with conventional displays. This makes the unit very efficient in terms of the components required and in terms of power consumption. Immediate applications include the display of information in public places such as airport terminals, and as desk-top units to display messages to individuals in large organisations.

The picture transmission system and the Betagraph were developed by the University in association with Deltec, a Perth electronics firm. Patents are held by the University.

Post Office meter monitors telephone use

Telecom Australia has approved a new meter which will enable subscribers to monitor charges for calls dialled from their telephones. The new meter, known as the Telemeter, is being introduced to meet a growing demand for this facility, and will progressively replace an existing meter.

Two types of Telemeter are available:

- a "Private Meter" which simply registers and accumulates meter pulses in unison with the exchange meter, and which is primarily intended for use in private homes and small businesses; and
- a "Control Meter" which must be reset after each STD or local call is made before further calls can be made. This facility is expected to make the unit attractive for shops, cafes, motels etc where proprietors are prepared to make a telephone service available to customers on a charge-per-call basis.

Rental for the private meter has been set at $12 per year, with no installation fee. For the Control Meter, a standard installation charge of $20 applies, while rental has been set at $48 per year. Inquiries show that there is likely to be a very strong demand for both meter types.

Miniature digital compass developed by AWA

A miniature digital compass, developed for Australia's defence forces, has attracted wide interest in Britain and the United States.

The compass, measuring only 65mm x 50mm and weighing 130g, uses modern integrated optoelectronics to achieve outstanding accuracy with rugged construction and low cost. It was developed by the Microelectronics Division of Amalgamated Wireless (Australasia) Ltd with support from the Australian Government.

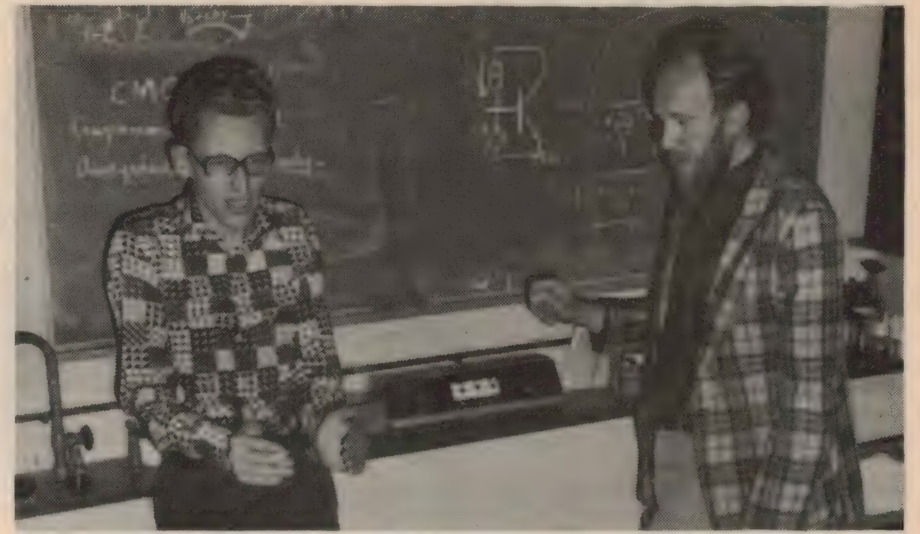
Based on the north-seeking principle, the digital compass operates by means of a photoelectric cell reading the movements of a transparent, coded compass card or disc. This disc is attached to a dual-magnet assembly mounted on a shock- proof, single-pivot bearing.

An infra-red LED illuminates the disc through a collimating lens to produce a shadow of the code pattern on a 10-element, monolithic photo-diode array The IC converts this information into a digital data stream to give a 4-digit numeric readout on the associated display unit. The readout is expressed in degrees relative to magnetic north.

Although designed specifically for use in Australian defence and scientific applications, the new compass is suitable for a range of other uses. These include marine and land vehicle navigation, surveying and remote monitoring.

Award to Philips scientists for I²L

. . . new technology looks set to eclipse CMOS



Mr C. Hart (left) and Mr A. Slob of Philips Research Laboratories, Eindhoven.

Mr C. M. Hart and Mr A. Slob of Philips Research Laboratories in Eindhoven, The Netherlands, were awarded the 1975 Achievement Award from the American magazine "Electronics" for their invention of integrated injection logic, or I²L. The award was shared with two German employees of IBM, Mr H. Berger and Mr S. Weidmann, who independently produced the same invention at about the same time.

Known alternatively as MTL (for merged transistor logic), I²L makes it possible to put a much larger number of logic circuits onto a single chip than was previously possible with bipolar techniques. Advantages of the comparatively new technology are such that it looks as though it will become the preferred LSI technology, eclipsing MOS and CMOS technologies.

In the past few years, I²L has contributed greatly in solving the problems met in the design of increasingly larger integrated circuits. It is easier to make than either TTL or CMOS; its gates and other elements are between 4 and 10 times smaller than those of either TTL or CMOS; it has the speed of TTL, but uses less power than CMOS; and it will operate at supply voltages down to about 1V.

In addition, I²L offers the IC designer greater freedom of layout. For a more detailed description, readers are referred to the December 1975 issue of EA.

New aids for the blind: electronic calculators . . . . . . and a paper money identifier

The American Foundation for the Blind has announced the development of two electronic calculators—one with a braille output and the other with a voice output—plus a paper money identifier to aid the blind.

The braille calculator consists of a standard five-function calculator which was modified by the foundation's engineering division to incorporate a single braille readout cell. Within the cell is a 2 x 3 matrix array of solenoid actuated pins. These are activated to give the appropriate readout in braille one decimal place at a time. A control feature enables the user to regulate the speed at which the braille digits follow each other.

The audible readout calculator was developed for the foundation by Telesensory Systems Inc. of Palo Alto, California. Designated Speech Plus, the unit has a 24-word vocabulary built into a speech-generating custom ROM IC that announces every entry and result. It has six basic functions, including square root and percent, automatic constant, a change of sign key, a floating decimal point, and an eight-digit visual display. Results are repeated at the press of a switch.

The pocket-sized paper-money identifier uses an infrared sensor to detect the dark and light areas of a bill of any denomination, and emits a low-pitched tone for dark areas and a higher-pitched tone for light areas. An instructional tape recording is supplied with the device to teach the operator to identify the tone pattern that is characteristic of a particular denomination. The unit, developed from NASA's biomedical-application program, is now manufactured by EMR Ltd, Los Angeles.

NEWS HIGHLIGHTS

22kV "zap" for Sydney's gas pipeline

One essential procedure involved in pipelaying on the Moomba to Sydney natural gas pipeline is the test and repair of any defects found in the coating on the 34-inch diameter pipes.

The 1300km long pipeline being built by The Pipeline Authority is scheduled to bring natural gas to Sydney in April, 1976.

Pictured is the test equipment that has been 'walked' over 800km from Mt. Hope near Cobar, in Central NSW since construction began in early 1974.

The testing machine incorporates a circular spring, to which a 22,000V charge is applied. A lead from the portable battery/transformer unit is attached to one end of the pipe in contact with the steel.

If there are imperfections in the coating, the electric charge jumps the gap between the spring and the steel pipe, and a warning device in the unit beeps loudly. Workmen then patch the coating before the pipe is lowered into the trench.

New RCA satellite for US communications

A new era in US communications history was begun recently with the launch of a new communications setellite—the RCA Satcom 1—from the Kennedy Space Center.

The new satellite is the first of three that RCA will operate as part of its Satcom domestic communications system, designed to provide telephone, video and data services to customers throughout the US. The spacecraft, now in geosynchronous orbit 36,000km above the equator, was scheduled to commence operational service in February.

Satcom 1 is the most advanced communications satellite ever put into commercial service. It has 24 independent communications channels or transponders, double the capacity of previously launched satellites of a similar nature. Each transponder is capable of handling 1,200 voice grade channels, one colour television transmission, or more than 60 million bits per second of digital data.

Initial satellite operations will be through nine existing RCA earth stations, with emphasis on Alaska services. These services include critical satellite operation for Alaska pipeline communications. An additional twelve RCA standard stations and up to sixty small earth stations are scheduled for operation with the RCA Satcom System in 1976.

Calculator doubles as a ballpoint pen

Hosiden Electronics, Japan, has claimed a world first with the development of an 8-digit calculator which doubles as a ball-point pen. Dubbed the "Calcu-pen", the unit is to be exported to the US market where it is expected to be a popular gift item.

In size and shape the Calcu-pen resembles an ordinary ball-point pen, being just a little larger in diameter. The body of the pen contains the display, together with five key switches. These incorporate the calculating figures, four basic arithmetic signs, percent and clear signs, and a decimal point. The key switches move in four distinct directions, vertically and horizontally, enabling the required function or number to be selected.

Hosiden is a company specialising in the manufacture of keyboard switches and other components for calculators. The Calcu-pen is a result of the company's technological research, although the LSI circuitry is supplied by Sharp Corporation.

Local thick film circuits in AWA-Thorn colour TVs

Hybrid Electronics Australia Pty Ltd has announced the successful development of reflow soldering techniques for thick film circuits.

Making the announcement, Wal Berryman, General Manager of Hybrid Electronics, said that these developments had enabled colour TV modules to be made in Australia for local manufacturer AWA Thorn. The modules developed include vertical amplifiers, oscillators and colour convergence circuits.

Solder reflow of standard components on to thick film resistor networks often provides the best cost-reliability optimisation for high-volume consumer and industrial electronics requirements. While not as dense in packaging as the conventional hybrid chip and wire approach, the advantages are significant in many product areas.

Local telecom industry wants Govt. action

The win by the Liberal-National Country Party in the Federal Election has sparked strong optimism that the telecommunications manufacturing industry in Australia will be revitalised. This was stated in a recent press release issued on behalf of the Australian Telecomunications Development Association (ATDA).

The chairman of ATDA, Mr T. E. Hodgkinson, commented: "We in the telecommunications and electronics manufacturing business were one of the first cabs off the rank to be hit by the low-protection policies of the previous Federal Government; so it is reasonable to suppose that we can expect some early relief, some real support for local industry in a nationally important field."

Mr T. E. Hodgkinson

Industry leaders are vitally concerned that the new Government take swift and decisive action to revive the industry before it loses its base as a viable entity.

The impact of radio on the maritime services

One of Guglielmo Marconi's principal concerns was to use wireless to end the isolation of ships at sea. In 1900 he formed a company with that express purpose in mind—a company that has since given 75 years of maritime service and is now a recognised world leader in this field. This article briefly traces through those 75 years of service, highlighting events of significant historical interest.

Seventy-five years ago, Guglielmo Marconi formed The Marconi International Marine Company on the very day that he celebrated his own 26th birthday—25th April 1900. The object of the company was to enable shipowners to rent wireless apparatus, the services of operators and the use of Marconi shore stations, so ending the isolation of those at sea. The services still operate today, though the shore stations in Britain are now under Post Office control.

In 1900, the year of his dramatic bridging of the Atlantic with Morse code transmissions, Marconi started to establish a network of permanent wireless stations specifically for maritime communication. Stations were built that year on the British and Irish coasts and in Belgium and Germany, while US stations on the Nantucket lightship and at Siasconcet were made available, and a station at Bell Isle in the Gulf of St Lawrence was nearing completion.

By the end of 1901, not only had the British and Italian Navies adopted the 'new device' but so too had the first British merchant ship, a number of foreign merchant ships, and the Cunard liners, "Lucania" and "Compania".

The value of Marconi's invention as a life-saver was established beyond question in 1909 when the wireless-equipped White Star liner "Republic" collided with the Italian ss "Florida". Before long, ships were converging on the scene in response to the wireless distress signals. For his devotion to duty during this traumatic experience, the Marconi radio operator Jack Binns assured himself of a place in the annals of maritime history.

Jack Binns, Marconi Wireless Operator, received an inscribed watch to mark his devotion to duty when the "Republic" and the "Florida" collided off the coast of America. Guglielmo Marconi made the presentation.

Above, Dr Crippen is led off the ss "Montrose" by Inspector Dew, following a wireless message from the captain of the ship to Scotland Yard. Photo at left shows early radio transmission and direction finding equipment installed on board a lifeboat.

as told by

the Marconi Company

During the first decade of the company's life, the number of wireless-carrying ships increased steadily, but it was the part that wireless played in the arrest of the notorious murderer, Dr Crippen, that supplied the drama. Captain Kendall of the "Montrose", suspecting that Dr Crippen and his mistress, Ethel le Neve, were aboard his ship bound for Canada, signalled New Scotland Yard by wireless and, on arrival in Canada, they were taken into custody by fast-travelling Inspector Dew of the Yard.

In 1912 came the tragic "Titanic" disaster. Those who survived owed their lives to wireless and to the devotion and bravery of the Marconi Marine radio officers, one of whom, 'Jack' Phillips, died at his post.

During the First World War, the company trained 3,300 operators for mercantile marine service, and 180 of its own radio operators lost their lives at sea. As often happens in time of war, technological progress hotted up. Radio direction finding was brought to a fine art, and the range of a ship's wireless telegraphy station was increased to between 2,000 and 3,000 miles. Wireless telephony too made headway, culminating in a large scale demonstration in 1920, when delegates of the Empire Press Union on board ss "Victorian" held wireless telephone conversations over distances in excess of 1,000 miles. The new Marconi direction finder was also demonstrated on this voyage, and within six years was adopted by over 200 ships.

Another war-time development to go into wide use was the Marconi auto-alarm which, unlike many wireless devices, actually enabled some ship-owners to cut down on expenses, as it performed the task of two wireless watch-keepers—formerly mandatory on certain ships.

The '20s also saw the introduction of sound reproducing equipment on board ships, and the 'Marconi Band Repeater', through its microphone, amplifier and loudspeakers, brought live and gramophone music to entertain those at sea.

Meanwhile, the fishing industry had not been slow to follow the example of the deep sea vessels, and by the late '20s, 191 trawlers and drifters carried company equipment. By 1930, the newly-developed Marconi echometer was bringing valuable underwater information, including fish locations, to trawlermen, as does its descendent today, the echosounder.

Two years after Guglielmo Marconi's death in 1937, Marconi Marine was again heavily committed to war work, provid-

Above, the ss "Lucania", the first Cunard ship to be fitted for transmitting and receiving wireless messages. She sailed on her first voyage with the apparatus on board on 15 June 1901. Below is the wireless room of a liner of 1912.

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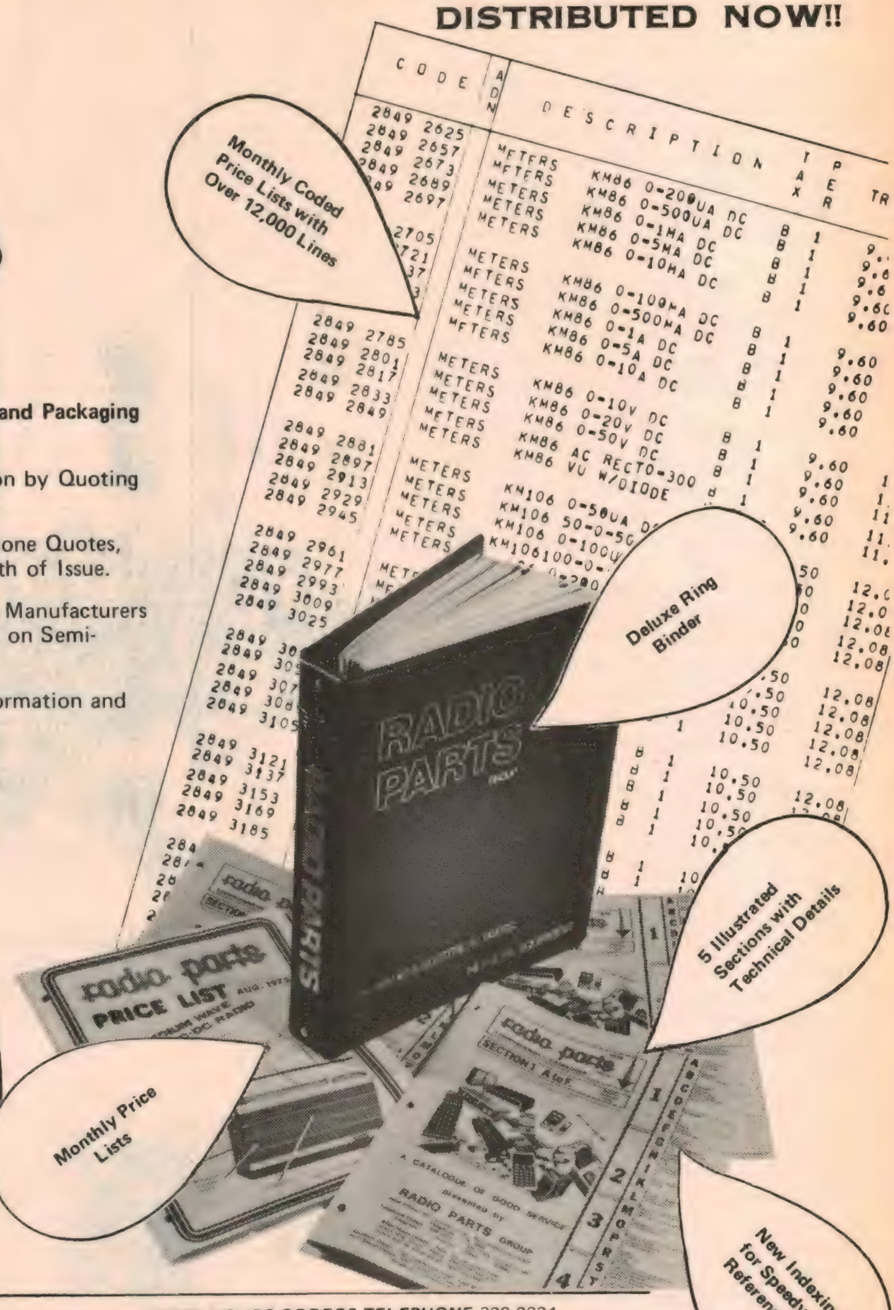

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At right, Empire Press Union delegates sailed to Canada in 1920 in the liner "Victorian". Marconi wireless telephony kept her in touch for practically the whole voyage, and concert programs were exchanged with the shore while in mid-ocean.

ing radio personnel for the British Merchant Navy and equipment for both British and allied shipping, and moving service depots along the line of battle for the benefit of ships coming into port.

After the war, Marconi Marine decided to direct the radar experience gained by The Marconi Company to the design of completely new equipment for peacetime shipping. In 1946, the first Radiolocator went on exhibition and a radar school was established in Chelmsford to train both shore and sea staff.

In its Jubilee year, 1950, the company received orders for re-equipping all the lighthouses and radio beacons round the coast of Britain. The following year it supplemented the already comprehensive Marconi Marine installation of the "Gothic" which, as the floating headquarters for the Commonwealth tour of the Queen and the Duke of Edinburgh, had to meet excessive communication demands.

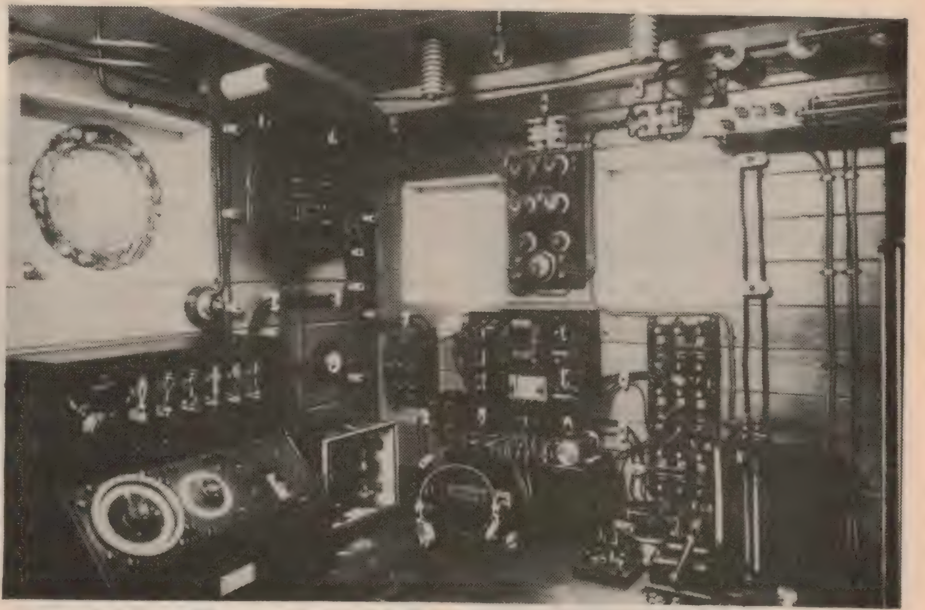
Notable in the '50s was the increasing use of VHF for maritime purposes. The company was ready to meet the demand with a new range of equipment, exploiting, in the late years of that decade, the advantages of the single sideband mode of operation, which has led directly to Omega, automatic Loran, selective calling and automatic error correcting systems that ensure accurate telex communication.

In the mid-'60s a vast new market for Marconi Marine opened up with the arrival of the first North Sea drilling rig. Over the years requirements have advanced from simple radiotelephone links with the shore to specially designed ISB (independent sideband) equipment providing simultaneous radiotelephony and teleprinter transmission.

1970 saw another piece of history being made when Dallas Bradshaw of Marconi Marine became the first woman radio officer to go to sea in the British Merchant Navy. The '70s have also seen the introduction of Marconi Marine electronics officers and the expanding use of the company's equipments, which include a variety of on-board entertainment systems and the spectacular, fully automatic anti-collision radar, 'Predictor'.

Since 1900, the company has led the way in marine electronics. A Queen's Award winner for export achievement, it offers to ships of all nationalities the widest range of electronic equipment available from any one company.

Reprinted from the Marconi publication "Aerial", by arrangement.



"King's Grey" wireless room—a typical trawler installation of the '20s.

The radio room of a modern trawler. The Polish-built Boyd Line "Arctic Buccaneer" has a complete Marconi Marine communications station.

Optical fibre techniques in avionics data transmission

The importance of suitable data transmission to the success of an overall avionics system has long been recognised. During the past decade, the Flight Automation Research Laboratory of Marconi-Elliott Avionic Systems Limited has included a team specifically briefed to investigate such data transmission requirements for avionic systems. One of the techniques investigated over the last five years is the transmission of data using fibre optics as the transmission medium.

by TREVOR A. MORGAN, B.Sc (Hons.)*

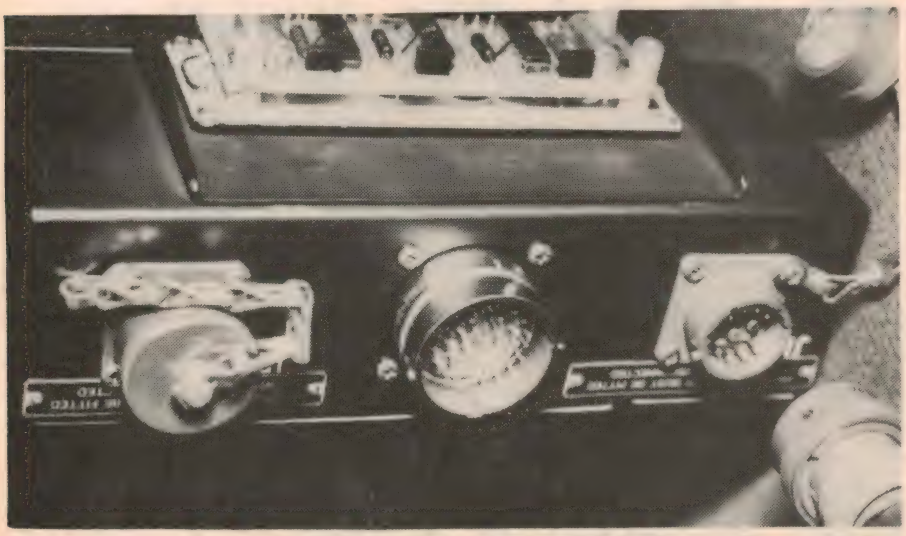
In general, fibre optic transmission systems may utilise either single or multimode waveguide. For single mode systems waveguide attenuations as low as 2dB/km with bandwidth capabilities of 10M bits/s/km have been reported. However, systems employing such fibres require a laser source and accurate optical connections (laser-to-fibre, fibre-to-fibre) for the launching and maintenance of mode propagation. This latter requirement may be acceptable for telecommunications where a cable is rarely disconnected, but is not suitable for avionic systems where maintenance requirements dictate the use of easily separable units.

Multi-mode waveguides are commercially available with attenuations of less than 100dB/km (20dB/km have been reported), and with bandwidth capabilities of 500Mbits/s. A broad range of off-the-shelf electro-optical devices in the form of light emitting diodes, photodiodes and avalanche photodiodes are available for use with such fibres. Single fibres may be used but the connector tolerances are eased by using a bundle of fibres (20—100) which also permits a certain amount of fibre damage without the total loss of transmission.

*Flight Automation Research Laboratory, Marconi-Elliott Avionic Systems Limited.

The efforts of the Flight Automation Research Laboratory have therefore been concentrated on multi-mode bundle systems using light-emitting diodes (LEDS) and p-i-n photodiodes for point-to-point transmission of digital signals. The input logic signal is modulated into a return-to-zero format, the duty ratio of which is dependent upon:

- the LED characteristics in terms of optical rise and fall times and maximum mean current permissible, allowing for life and temperature degradation;
- the maximum attenuation between LED and photodiode due to optical cable and connectors;
- the radiation levels at the photodiode to give the necessary signal-to-noise ratio to meet error-rate requirements in conjunction with the design complexity of the receiver in terms of bandwidth and overall gain.



This optical coupler unit forms part of the new digital Flight Control Electronics System for the Boeing YC-14 Advanced Medium STOL transport aircraft. Main advantages include complete electrical isolation and no EM interference.

The resulting modulation is input to a current amplifier, the output of which drives the LED in the forward bias mode. The output radiation from the LED is normally coupled into the fibre optic bundle by locating the polished fibre end in close proximity to the LED.

The resulting combination is usually a bulky and inefficient lens. However, special communications devices similar to the Burrus diode devices are now being constructed with large diameter fibre tails. The output from these devices is coupled into the fibre bundle using a fibre bundle connector which can give as little as a 3db power loss across the interface. For fully practical systems, taking into consideration maintenance and installation requirements, this solution is preferred.

The same problem exists at the receiver end and the same provisos apply. The losses, however, at this interface are reduced by using large area chip devices.

The received signal is seen as a low-level current from the photodiode. Typical conversions are 0.5A/W for p-i-n photodiodes and 80A/W for avalanche photodiodes. The avalanche device unfortunately requires an accurately controlled bias voltage, which causes considerable design problems when dealing with an operating temperature range of −55°C to +125°C.

There are several methods of achieving current-to-voltage conversion at the head amplifier. Systems have been built in the laboratory using either a transimpedance amplifier, or by driving a load resistor with the photocurrent and amplifying the resulting voltage signal with a voltage amplifier.

Output from the head amplifier is input to a level detector, the output of which is a transistor transistor loop (TTL) level signal. This signal is demodulated back to the original form input at the transmitter.

The techniques described have been used in the development of several systems over the past years. These are briefly outlined in the following paragraphs:

(1) A multiplexed data transmission system capable of multiplexing analog and digital information to a maximum of 300 channels. The multiplexed data is

transmitted serially over two fibre optic channels, 20 metres in length and at a rate of 100kbits/s. The received light input is reconstituted and demultiplexed to its original form. This system was built under contract to the U.K. Ministry of Defence and was successfully operated in flight in 1971 and 1972.

(2) A 75-metre, 5Mbits/s airborne computer optical link was developed for the Ministry of Defence in 1973. The system was built using 400dB/km fibres, a large diameter chip LED, and an avalanche photodiode. Automatic rear mounted rack connectors interface transmitting and receiving devices with the fibre bundles. The system allowed the asynchronous transfer of stored data from one computer to the other and vice versa and replaced a point-to-point wiring system requiring approximately one hundred, 70-metre lengths of triple twisted cable.

(3) During the course of a Ministry of Defence sponsored research programme into failure survival digital flight control systems, a quadruplex, high integrity, flight control system demonstration rig was developed using a self-clocking fibre optic data transmission system between channels. The optical system was used to crossfeed data between channels for signal consolidation and fault detection. Each channel provides three 2Mbits/s optical data outputs into fibre bundles which connect to the optical inputs of each of the other channels.

A practical realisation of this prototype was seen in Marconi-Elliott's high integrity digital flight control electronics system recently built for the Boeing YC-14 Advanced Medium STOL transport. In this system, optical data transmission is used to compare command signals between the redundant lanes.

The use of fibre optics in such a system offers the following advantages over similar systems employing conventional electrical data transmission:

- Complete electrical isolation precludes the propagation of electrical faults from one channel to another, thus maintaining high integrity and also reducing the risk of induced electrical fires and other catastrophic damage.
- No errors are introduced into the system via the transmission medium from electro magnetic interference.
- Possibility of high bit rates without fear of radiation incompatibility with other systems.
- Reduced risk of system re-design due to incompatibility during the aircraft system integration stage.

The examples given demonstrate the practicability of optical data transmission in avionics. The efforts of the research team are now directed towards consolidating the techniques and experience gained to produce practical optical transmission systems compatible with normal aircraft and manufacturing techniques.

At last: an electronic organ that's easy to build!

Building an electronic organ is now a far less daunting job than it was even a year or two ago, thanks to the advances made in IC technology. This is the first of a short series of articles written to show you how to take advantage of the new technology—first in building a basic minimum-cost single manual organ, and then in expanding on the simple design to produce more pretentious instruments.

by JAMIESON ROWE

Sooner or later many electronics enthusiasts seem to develop an interest in building an electronic organ. Perhaps this is because such a project offers not only the usual challenge of building a piece of equipment and getting it going, but also the opportunity to acquire an instrument for family entertainment and enjoyment—and hopefully at an attractive price.

In an effort to satisfy this interest among our readers, EA has published in the past a number of articles on electronic organs and organ building. Noteworthy among these were the articles of May-June 1955 by R. A. B. Tarrant, and those of November 1961-August 1962 by present Editor-in-Chief Neville Williams describing the Stromberg-Playmaster organ. Since then there have been other articles dealing with various aspects of organs such as reverberation units and vibrato modulators, together with descriptions of small "toy" instruments.

Since the description of the Stromberg-Playmaster organ we have not attempted to describe another "serious" instrument, however, despite indications that there existed plenty of potential reader interest in such a project. One reason for this was that many of the essential parts were in poor and unreliable supply—keyboards, for example.

Another reason was that the cost of commercial instruments had fallen to the level where it would be very difficult to achieve any worthwhile saving by the do-it-yourself approach—particularly when a full-scale organ project tends to involve a great deal of time and effort; far more than many would-be builders expect.

These reasons made it very difficult to justify either our own development of an organ project, or the publication of articles encouraging readers to commit their time and money.

Just recently, we became aware that this situation has begun to change for the better, once more as the result of developments in integrated circuit technology. It is now possible to generate all of the notes required even for the various pitches of a pretentious organ, using a mere handful of ICs and other components on a single modest-sized printed circuit board (PCB). And the resulting note generator needs no tuning as such, the note relationships being locked permanently in a very close approximation of the tempered musical scale.

As many will appreciate immediately, this represents a most dramatic advance over what has been possible in the past. It means that now the note generator can not only be far simpler and easier to build, but also vastly easier to get going and maintain. There is no need for the initial tuning hassle which presented a major hurdle to constructors in the past, nor will there be any need for retuning later on.

There is also a cost advantage, at least as far as the note generator itself is concerned.

As soon as we realised the possibilities in this direction, we decided to re-examine the idea of an electronic organ project. And the prospect certainly looked more promising than before, mainly because of the developments with regard to the note generator. But there were still problems to be overcome.

The main hassle concerns keyboards. These have always been a problem; in the past those keen to build an organ generally had to obtain an old harmonium keyboard, and spend much time and effort in adding suitable switch contacts. This perhaps added to the challenge for the real fanatics, but understandably it provided a stumbling-block to deter almost everyone else.

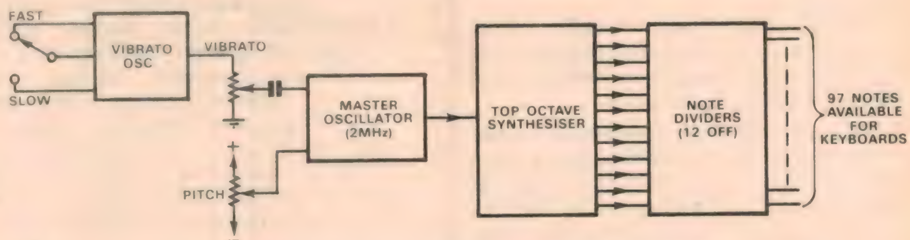


FIG. 1 PLAYMASTER 760 ORGAN—NOTE GENERATOR—BLOCK DIAGRAM

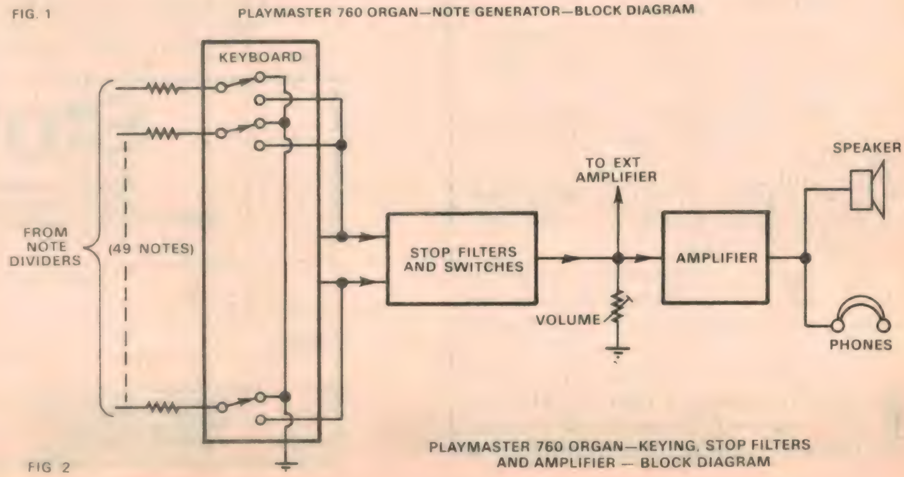


FIG 2 PLAYMASTER 760 ORGAN—KEYING, STOP FILTERS AND AMPLIFIER — BLOCK DIAGRAM

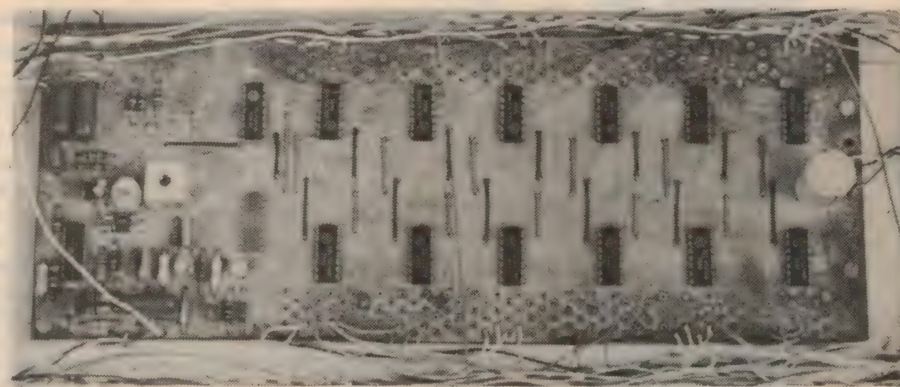
In the case of the Stromberg-Playmaster project, moulded keys were available at the time, along with keyboard frames and matching hardware to provide suitable switches of the single-pole variety. This allowed constructors to assemble an attractive keyboard with only a moderate amount of effort. Unfortunately most of the hardware for that project has long since dried up, although we understand that quantities of the original fully-moulded keys (less the switches) are available at 10c per key from the firm Electronic Arts, of 126 Bombay Street, Lidcombe NSW 2141. These may provide a solution for those with the necessary time and patience.

The ideal solution would be completely assembled keyboards, preferably with multi-pole switches fitted to each key, so that the builder would not be involved in a lot of tedious and rather fiddly assembly work. Such keyboards appear to be available from time to time overseas, although they are not really easy to come by even in Japan or the USA. And they are not cheap when you can get them—which is hardly surprising, as their assembly involves a fairly high labour content.

After a good deal of enquiry locally, we have been able to nominate only one firm able to offer virtually immediate supply of assembled keyboards. The firm is Dick Smith Electronics, and the keyboard they can supply is a very nicely made 4-octave unit with single pole switches. This is quite adequate for a small organ, and although its modest compass and switching limitations make it less than ideal for more elaborate instruments, there are now ways of getting around most of the limitations.

Other keyboards more suitable for larger instruments may possibly become available later but, for the present, it would appear that these are likely to be the only keyboards available for the immediate future. They are available at a price which although not cheap, is at the same time not unreasonable. Bought separately it will cost you $97.50 including sales tax, although Dick Smith Electronics tell me they hope to whittle this down when the keyboard is bought as part of an organ kit.

Above is the simple organ, photographed before it was completed by the addition of a lettered front panel and music rack. Below is a view of the note generator board, which actually provides all 97 notes required for quite pretentious organs.



In view of the availability of these keyboards, we decided to go ahead with a new organ project—hence this article and those which are planned to follow.

Please note, however, that the approach we will be adopting is intended to be of maximum help to the largest number of interested hobbyists—often with little or no previous experience building electronic organs. The designs presented are not intended primarily for the committed organ enthusiast wishing to produce a "no holds barred" juggernaut, although some of the modules should be of considerable interest to such people.

We are first of all going to describe a very simple and minimum-cost single manual organ—as shown in the pictures. This incorporates a complete note generator module which takes full advantage of current IC technology. The note generator module is in fact directly suitable for use as the heart of far more pretentious instruments, and in later articles we plan to tell you how to either upgrade the simple organ or build a more elaborate instrument from scratch.

Presenting the new note generator initially as part of a very simple organ makes sense, because it is just such a project which it will benefit most. Not only this, but the resulting organ is so delightfully easy to build that we believe it offers an ideal way for those with no previous experience to "get started".

By the way, don't think that the simple organ is a mere toy. It has an entirely practical 4-octave compass, two-speed vibrato of adjustable depth, a split keyboard facility, control of absolute pitch over a range of ± 3% (to allow playing with other instruments), and four stops which are capable of a surprising range of different tone colours at the basic 8ft pitch.

In short, we have designed the simple organ with care so that despite its modest pretentions it should be capable of entirely musical and satisfying performance. As such it should be very suitable for the beginner to learn the rudiments of organ playing, or as a low-cost practice instrument for the professional organist.

The main advantage of the simple

organ compared with similar small organs available commercially is that it may be readily expanded into a more pretentious instrument, if and when you so desire.

As a matter of interest, we estimate that a kit of parts for the basic organ as described should be in the order of $170, which compares quite well with commercial mini-organs.

At the heart of the basic organ is the note generator module, as already noted. The block diagram for this module is shown in Fig. 1, with the remaining sections required for the simple instrument shown in Fig. 2. As you can see, the note generator consists of four main sections: a vibrato oscillator, a master note oscillator, a top octave synthesiser and a group of 12 note dividers—one for each note of the tempered musical octave.

It is the last two of these main sections, the top octave sythesiser and the note dividers, that represent the most dramatic changes from previous organ techniques. The top octave sythesiser consists of a single IC, which simultaneously divides a single input signal from the master oscillator by 12 different ratios to provide the 12 notes of the uppermost octave on a 2ft organ stop.

These 12 notes are then taken by the note dividers, and each one is divided by two the appropriate number of times, to provide the notes of all the lower octaves. In the case of all of the notes except C, this involves 7 divisions by two, to give a total of 8 octave versions of each note. An additional division is required for C, because 9 octave versions of this note are required—one at the top of each octave, and a final one at the bottom of the very lowest octave.

A single IC is used to provide all 7 of the binary divisions for each note—that is, one IC for each of the 12 note dividers, or 12 divider ICs in all. An additional IC is used to provide the eighth division for

Organ terminology explained . . .

For those unfamiliar with organ terminology, many organs have facilities to sound a number of different notes — either singly or together — when each key is pressed. The organ is said to be sounding in "unison" or 8ft pitch when pressing each key results in the same note which would be produced by pressing the corresponding key of a piano. The term "8ft" comes from pipe organ practice, where the largest member of a rank of open pipes sounding this pitch has a speaking length of approximately 8 feet.

If the note produced when a key is pressed is an octave lower than the note in 8ft pitch, the organ is said to be sounding in 16ft pitch. Similarly if the note is an octave higher than the note in 8ft pitch, this is described logically as 4ft pitch. If it is two octaves higher, this is described as 2ft pitch. Some instruments are capable of sounding notes three octaves higher, or in 1ft pitch.

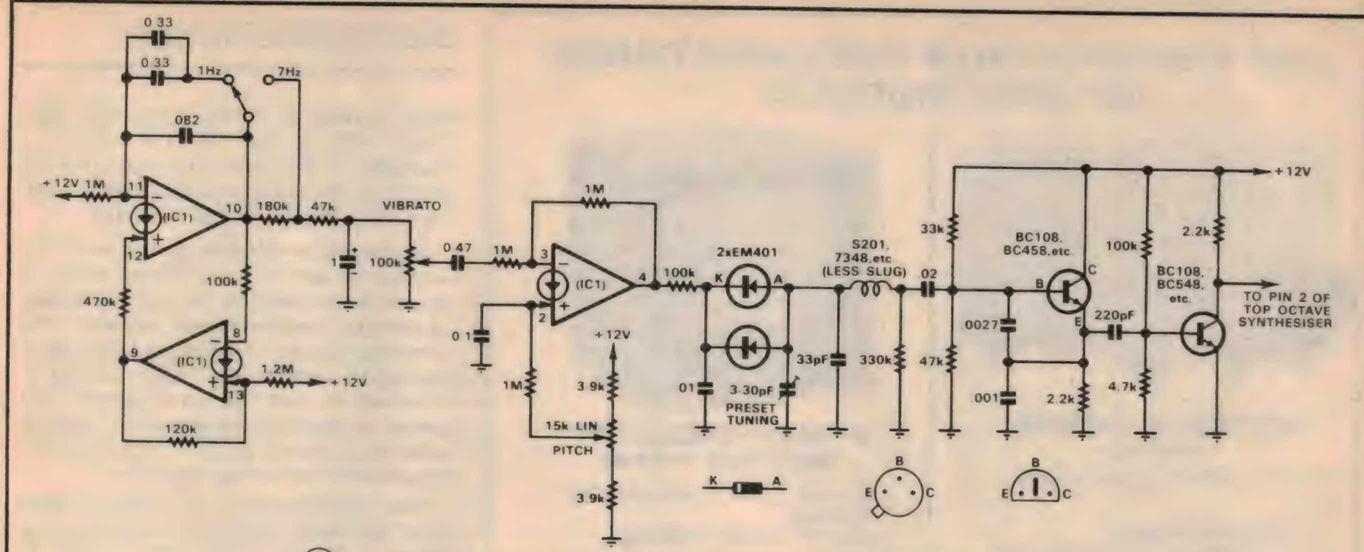
In addition to providing such facilities for sounding notes which are related to unison pitch by integral octaves, more pretentious organs may be capable of sounding other notes which although harmonically related are not separated by whole octaves. These are described generally as "mutation" pitches, and are designated by fractional footages such as 2-⅔ft, 1-3/5ft, 1-⅓ft, and more rarely 5-⅓ft and 10-⅔ft.

The important point to grasp about the various pitch facilities which may be provided on an organ is that they are not mutually exclusive. Although it is usually possible to use any pitch singly, and this is often done, they may also be used together in various combinations to achieve interesting or musically satisfying results.

Control of the various pitches is usually achieved by the stop knobs, tablets, rockers or drawbars, along with the control of tone colour. This is done by providing the various tone colours in various pitches. Thus a theatre-type organ may provide the flute-like tibia tone colour in various pitches, with tablets marked "Tibia 8ft", "Tibia 4ft", "Tibia 2ft" and so on. Similarly a classical-type organ may provide the traditional diapason tone colour in a range of pitches, although here the rockers or drawstop knobs may be given names like "Diapason 8ft", "Principal 4ft", Twelfth 2-⅔ft" and "Fifteenth 2ft".

The same applies to the tone colours based on imitation of string and other orchestral instruments, although here the stop names tend to vary more with pitch — the idea being to suggest various instruments. Thus a stop tablet providing string tone in 8ft pitch may be labelled "Gamba 8ft" or "Salicional 8ft", but another providing string tone of 4ft may be marked "Violin 4ft" or "Salicet 4ft". Similarly the equivalent of an 8ft stop control marked "Oboe 8ft", in 16ft pitch may have the marking "Bassoon 16ft".

Organ keyboards designed for playing with the hands are known as "manuals", while a keyboard for playing with the feet is a "pedalboard". The number of keys provided on a manual or a pedalboard is known as its "compass". Concert organs have a manual compass of 61 notes (5 octaves) and a pedalboard compass of 32 notes (2½ octaves), but smaller organs may have a reduced compass for both manuals and pedalboard.



PLAYMASTER 760 SERIES ORGANS—MASTER OSCILLATOR AND VIBRATO

C. Thus a total of only 14 ICs are involved in generating the complete range of 97 notes—from the bottom of 16ft pitch to the top of 2ft pitch!

The top octave synthesiser is a P-channel MOS divider IC, with the type number 50242. It is made by two different US manufacturers, American Microsystems Inc (who call it the S50242) and Mostek (who call it the MK50242). In Australia these firms are represented by the firms Cema (Distributors) Pty Ltd and Total Electronics Pty Ltd, from whom they may be ordered via normal suppliers.

A device similar to the 50242 but of earlier design is made by General Instrument Microelectronics, and called the AY-1-0212. This is pin compatible with the 50242, except that it requires a −12V supply in addition to the nominal +13V required by the later device. Provision has been made on the tone generator PC board for you to use the AY-1-0212 device if you prefer, although this will of course involve the provision of extra power supply circuitry.

The note divider ICs are standard CMOS devices, type 4024A. These are made by a number of overseas manufacturers, including RCA and Solid State Scientific. In the prototype tone generator I used Solid State Scientific devices, which are coded SCL4024AE. These may be ordered through your usual supplier from Cema (Distributors) Pty Ltd.

The additional binary division required for the C notes is provided by another CMOS device, the 4013A (SCL4013AE or similar). This is actually a dual type-D flip-flop, so that only half the device is used for the additional C divider. The PCB pattern has been arranged so that the remaining half of the device can be used for another purpose in more elaborate instruments.

The master oscillator section of the tone generator uses discrete circuitry, as shown in Fig. 3. The oscillator itself is a modified Colpitts circuit, using a BC548 or similar NPN transistor. It operates at a nominal 2MHz, and the oscillator coil is a miniature type made for transistor radios (Jabel type 7348, Aegis type S201 or similar). Output signal is taken from the oscillator at the emitter, and fed to the input of the 50242 top octave synthesiser chip via a buffer/squarer stage using another BC548 or similar transistor.

In order to make the oscillator coil resonate at a nominal 2MHz with the effective capacitance provided by this circuit, its tuning slug must be removed. However adjustment of the oscillator to its correct nominal frequency is possible via the 3-30pF trimmer.

I have used the term "nominal frequency" in the foregoing because the actual oscillator frequency varies in two ways—one as a result of the effect of the pitch control, and the other due to the modulation from the vibrato oscillator. Both of these control the oscillator frequency via the two parallel power diodes (EM401 or similar), which are used as varicaps.

The vibrato oscillator does not use the phase-shift circuit used in so many previous circuits. The phase-shift circuit has proved notoriously cranky and unreliable, particularly when one tries to switch it between two very low frequencies as is required here. It also requires three substantially matched and high-value capacitors for each speed.

Instead I have used a very simple and reliable oscillator based on two sections of an LM3900 IC, which is a quad Norton op-amp device. This is a very economical oscillator, which can be easily switched between the two speeds required by changing the value of the single capacitor

PARTS LIST FOR NOTE GENERATOR

1 PC board, 280 x 106mm, code 76/EO2G
1 Transistor oscillator coil, Jabel type 7348 or Aegis type S201 or equivalent
1 S50242, MK50242 or AY-1-0201 IC (see text)
12 SCL4024AE or similar CMOS ICs
1 SCL4013AE or similar CMOS IC
1 LM3900 quad Norton op-amp IC
2 BC548, BC108 or similar
2 EM401 silicon diode, or varicaps

RESISTORS
¼W 5% type: 2 x 2.2k, 2 x 3.9k, 1 x 4.7k, 1 x 33k, 2 x 47k, 6 x 100k, 1 x 120k, 1 x 180k, 1 x 330k, 1 x 470k, 4 x 1M, 1 x 1.2M
1 15k linear pot
1 100k linear pot

CAPACITORS
1 3-30pF PC type trimmer
1 33pF NPO ceramic
1 220pF NPO ceramic
1 1000pF polyester
1 2700pF polyester
1 .01uF greencap
1 .02uF greencap
1 .082uF greencap
1 .01uF greencap
2 0.33uF greencap
1 0.47uF greencap
1 1.0uF 10VW tantalum
1 470uF 16VW PC electrolytic

MISCELLANEOUS
Lengths of hookup wire for links, connections to vibrato and pitch controls, power supply. Solder, etc.

NOTE: Resistor wattage ratings and capacitor voltage ratings, where given, are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.

used. A value of .082uF gives the usual "fast" vibrato rate of 7Hz, which is changed to the slow "chorus" rate of about 1Hz by using two additional 0.33uF capacitors to give a total of 0.74uF.

The oscillator does not give a sinewave output; in fact it can deliver either a square or a triangular wave, depending upon which output is used. However by using the triangular wave and passing it through a simple R-C filter which is switched to suit the two speeds, we obtain an approximate sinewave output which in terms of vibrato cannot be distinguished from a true sinewave.

The signal from the RC filter is taken to a 100k linear pot, which becomes the vibrato amplitude control. The degree of vibrato may thus be varied from zero (i.e., no vibrato at all) to maximum—about ± 1 semitone, which should be more than adequate.

The vibrato signal from the pot is AC coupled to one input of a third op-amp element of the LM3900 IC. This element is used as a unity gain buffer, driving the two varicap diodes to modulate the frequency of the master oscillator.

The second input of the buffer is taken to the pitch control, which is a 15k linear pot connected in series with two limiting resistors across the 12V supply rail. Varying the pot thus alters the quiescent DC bias applied to the buffer op-amp, and its output accordingly follows suit to vary the quiescent reverse bias on the varicaps. Hence the average frequency of the master oscillator may be varied, to move the pitch of the entire instrument. The range provided is about ±3%, which should be more than enough to allow the organ to be matched to an existing piano or other fixed-pitch instrument.

The complete 97-note generator circuitry is built on a single PC board which measures 280 x 106mm, and is coded 76/EO2(G). Patterns for the PCB are available from our Information Service, although ready-made boards should be available from the usual suppliers.

The wiring diagram for the note generator board is shown in Fig. 4. As you can see, there are surprisingly few components involved, despite the fact that the generator provides all of the notes required for even quite pretentious organs. Each of the 97 note outputs is provided with three terminal pads, to facilitate multiple connections with larger organs.

You may have noticed already that the PC pattern obviously provides for an additional IC, yet no device is shown in that position. The additional device is a 4016A quad switch, which may be used in conjunction with the currently unused half of the 4013A device for stop combination switching in more elaborate

instruments. It is not used when the board is wired up for the simple organ.

Wiring up the note generator board should be fairly straightforward using Fig. 4 as a guide, even for those with little previous experience building electronic projects. The main thing is to use a small soldering iron, to avoid overheating the components or the PC board, and to make sure that you wire in the IC's and other polarity-sensitive components the correct way around.

I should point out that ICs 2-15 are all MOS devices, and although they are all provided with internal protective circuitry, it is wise to take the appropriate care when handling them and soldering them into circuit. I recommend the following procedure:

- Wire all other components onto the board before these ICs, including all of the wire links.
- Make sure the soldering iron tip and barrel are reliably earthed.
- Connect the earthy supply lead of the board to the same earth, before soldering in the MOS ICs, and until all are soldered in place.
- Handle the ICs as little as possible before fitting them to the board.
- Solder the earthy and positive supply pins of each IC to their PC pad before soldering the other pins.

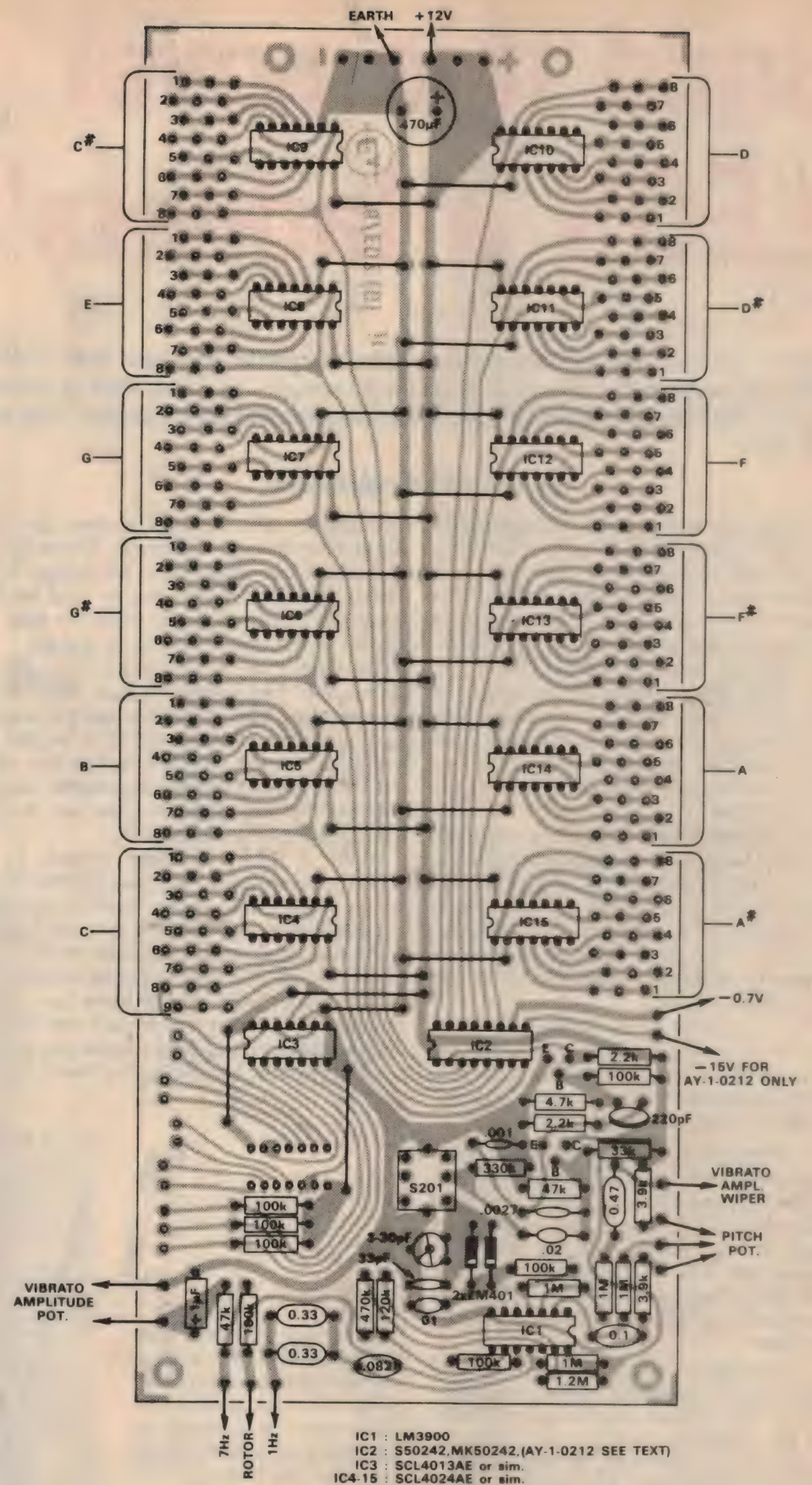
This may seem a little cautious, but some other writers have advised even more stringent precautions such as earthing yourself to ensure that you are not carrying a static charge! Frankly I have never believed it necessary to go further than the procedure given above, and I have even removed and refitted MOS devices to various boards without them being damaged. So if you follow the procedure I have given, you shouldn't have any trouble. Written down it may seem involved, but in practice it is really very simple.

A further point to note is that the nominal "earth" pin of the 50242 top octave synthesiser IC is not earthed directly, but is brought out to the side of the board and marked "−0.7V". It is necessary to peg the Vdd level of this device at a slightly more negative potential than the earth line of the note dividers, to ensure reliable drive to these ICs. This is because the top octave synthesiser is a P-channel MOS device, while the dividers use CMOS technology.

The voltage differential necessary to ensure reliable operation is only 0.7V, which is provided easily by inserting a silicon diode in series with the negative return of the power supply. This will be shown next month, along with the remainder of the circuitry for the small organ.

No circuit diagram has been given for the top octave synthesiser and divider sections of the note generator module, as these consist of little more than the ICs involved. The only other components are a 470uF/16VW supply bypass electrolytic capacitor, and three 100k resistors used to pull up inputs of the currently unused half of the 4013A device. These are shown on the PC wiring diagram in Fig. 4.

A parts list for the note generator module is given in this article for the benefit of those wishing to "get started" with construction. The parts needed for the remainder of the simple organ will be given in the second of these articles.



PLAYMASTER 760 SERIES ORGANS—NOTE GENERATOR BOARD

Here is the wiring diagram for the note generator board. Note that all but one of the ICs are CMOS devices, which should be handled with care; full details of this are given in the text, for those without previous experience.

Build this novel 'LEDS & ladders' game!

Here is a low cost pocket-sized electronic game that will test your patience and sense of timing. Seemingly simple, you may find to your dismay that literally hours of practice are required before you can ''reach the top''.

by DAVID EDWARDS

As you can see from the photographs, our new game consists of a small box, fitted with two switches, sixteen small light emitting diodes (LEDs), and an illustrated front panel. The illustration is a schematic drawing of a well, with a ladder reaching from the bottom to the top. The LEDs are arranged on the rungs of the ladder, representing successive foot positions as the ladder is climbed. The topmost LED, which is a different colour to the other ones, is on the ground at the top of the well.

When the POWER switch is pressed, the bottom LED commences to flash at a two second rate. The object of the game is simply to make the LED climb the ladder, by appropriate manipulation of the CLIMB button. Success is signified when the different coloured LED at the top is illuminated.

The trick in the game is that the CLIMB switch can only be operated when a LED is on. When this condition is satisfied the LEDs illuminate in turn, to simulate the effect of a light climbing the ladder.

If, however, the CLIMB switch is pressed when no LED is illuminated, the player is surprised and infuriated to find that when a LED comes on again, he is back at the bottom of the well. Of course, the device is scrupulously fair, so that even if the switch is only pressed for the shortest of times, back to the bottom he goes!

So, having limbered up his wits, as well as his switch operating finger, our player attacks the infernal machine again. With his eye glued to that first LED, and his finger poised, he waits for that light to come on. Flash!, the LED emits, his finger stabs the button, and the LED commences to climb!

One! two! three! four LEDs emit in turn, the button is released, and a fraction of a second later, the LED goes out. With bated breath, our player scans the LEDs, and is rewarded by seeing the fourth LED come on again. Once more he stabs at the button, once again the LED commences to climb.

Some time later, the fifteenth LED casts a ruddy glow over the perspiring face of our player, who decides to stop for a short time to wipe his brow. Those last few steps had seemed to be harder to climb than the earlier ones, in fact, he'd only just managed to go from the fourteenth to the fifteenth rung in one go.

Directing his attention back to the game, our hero is horrified to find that he's slipping back down the ladder, now only the fourteenth LED is alight. Desperately, he punches mindlessly at the button, the LED climbs up higher, just reaches the top, and then goes out. And he's still pressing the switch!

With a heart-rending groan, he releases it, and then watches dejectedly as the lowest LED flashes merrily. Some minutes later, he musters his courage, and once more commences to climb.

Just in case you're wondering whether or not it is possible to reach the top, we can assure you that it is. In fact, the little man at the top is waving to show you that he managed it, so don't lose heart and give up.

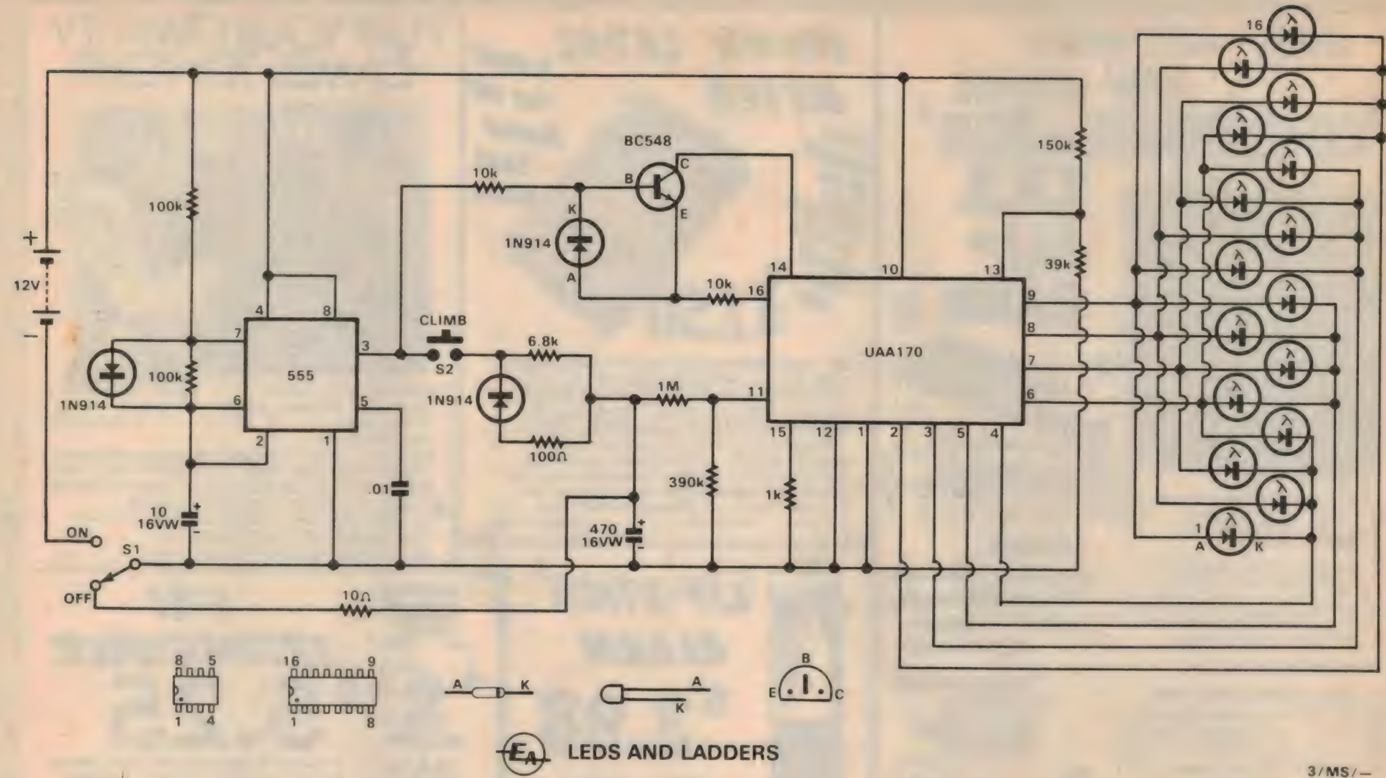
Turning now to the circuit diagram, we can examine its various sections, and see exactly how the game operates. The 555 type IC functions as an astable multivibrator. The frequency of operation is determined by the two 100k resistors and the 10uF capacitor. The diode connected between pins 6 and 7 serves to make the mark/space ratio unity, while the 0.01uF capacitor connected to pin 5 ensures reliable triggering.

The output from the timer is obtained at pin 3, and is in the form of a squarewave with an amplitude only slightly less than the supply voltage. The CLIMB push-button connects this pin to a large electrolytic capacitor, via a diode/resistor network.

If the CLIMB button is pressed when the voltage on pin 3 is high, the diode is reverse-biased, and the 470uF capacitor is charged via the 6.8k resistor. When the button is released, the capacitor commences to discharge through the 1M and 390k resistors. However, the time-constant is very long, of the order of 10 minutes, so that for the moment we will assume that the capacitor retains its charge indefinitely.

However, if the CLIMB button is pressed when the voltage on pin 3 is low, the diode is forward biased, and the capaci-

You can see from this illustration how we have arranged the LEDs on the ladder rungs. The one at the top is a different colour, to signify success. Instructions detailing how to play are included on the front panel.



The complete circuit diagram for the game. The LED numbered 1 is placed at the foot of the ladder, and the one numbered 16 at the top.

tor discharges rapidly through the 100 ohm resistor. Thus the capacitor voltage represents the distance up the ladder that the operator has climbed.

Since the capacitor is charged from a constant voltage, the voltage across the capacitor follows an exponential law with respect to time. This means that the initial rate of change of voltage is much higher than the rate towards the end of the charging period.

Thus a given closure time of the CLIMB switch will propel the "player" quite a few rungs up the ladder if he is near the bottom, but only one rung or less if he is near the top. This is why our hypothetical player found the going harder at the top of the ladder.

A second feature arising from this exponential curve is that the rate of discharge is greatest at the top of the ladder, so that an error in timing there produces a greater fall down the ladder than a corresponding mistake at the bottom. Now you can begin to see why the game is so infuriating

The power switch is placed in the negative supply line, and is a changeover type. This is so it can be used to discharge the 470uF capacitor, through a 10 ohm limiting resistor, when the power is turned off.

We can now turn to the second section of the circuit. This is the conversion from the capacitor voltage to the LED display. The heart of this is the new UAA170 IC, a 16 pin DIL plastic encapsulated device distributed in Australia by Siemens Industries Limited, who have offices in all major states. Order it from them via your usual supplier.

Internally, the UAA170 consists of a set of fifteen comparators. These compare the input voltage with a proportion of the supply voltage, and hence drive 16 LEDs. A matrix encoding scheme is used to reduce the number of connections required for the LEDs from 32 to 8. A zener diode is used to generate a stable voltage for powering the LEDs, so that their brightness is independent of the supply voltage.

By varying a single resistor, it is possible to vary the LED current over a wide range. The comparator and encoding network is arranged so that each LED is illuminated in turn, so that when they are arranged in a line, the effect is of a point of light moving along the line. It is possible to adjust the transition between LEDs to be either abrupt or gentle.

All this is contained in a single 16 pin IC, whose current consumption is typically 4mA (neglecting the LED current). The maximum LED current available is 50mA.

Pins 12 and 13 are the reference inputs to the comparators. The voltage applied to pin 12 becomes the lower threshold, while the voltage applied to pin 13 becomes the upper threshold. We have grounded pin 12, so that the first LED will turn off when the voltage applied to the control input goes slightly positive.

The sixteenth LED will be illuminated when the voltage on the control input exceeds the voltage on pin 13, while for voltages in between these two extremes, corresponding LEDs will be illuminated. Note that when the threshold between two LEDs is being crossed, both LEDs will be partially illuminated.

The control voltage is applied to pin 11 from the voltage divider formed by the 1M and 390k resistors. These values have been chosen in conjunction with the values for the divider connected to pin 13 to ensure that it is possible to turn on the sixteenth LED. *(over)*

PARTS LIST

1 555 timer IC
1 UAA170 LED driver IC
1 BC548 NPN transistor, or equivalent
3 1N914 or 1N4148 silicon diodes
16 small LEDs
1 470uF 16VW PCB mounting electrolytic capacitor
1 10uF 16VW PCB mounting electrolytic capacitor
1 0.01uF plastic capacitor
1 1M, 1 390k, 1 150k, 2 100k, 1 39k, 2 10k, 1 6.8k, 1 1k, 1 100 ohm & 1 10 ohm ¼W resistors
1 N/O push-button switch
1 single pole changeover switch, push-on, push-off
8 1.5V penlight cells
2 holders to suit
2 battery clips to suit
1 printed circuit board, 71 x 71mm, coded 76g3
1 plastic case, 159 x 96 x 50mm
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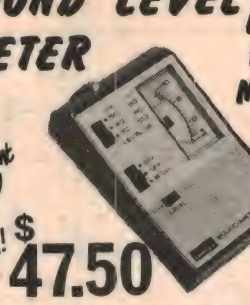

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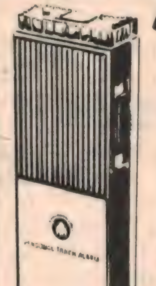

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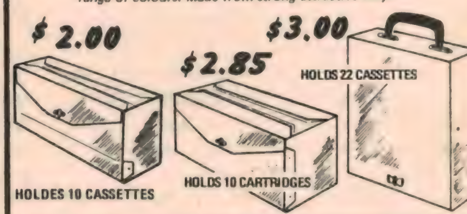

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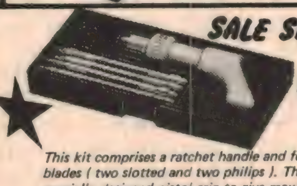

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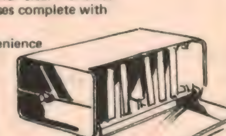

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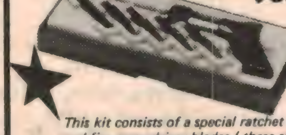

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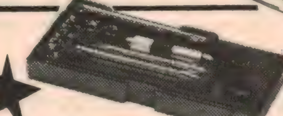

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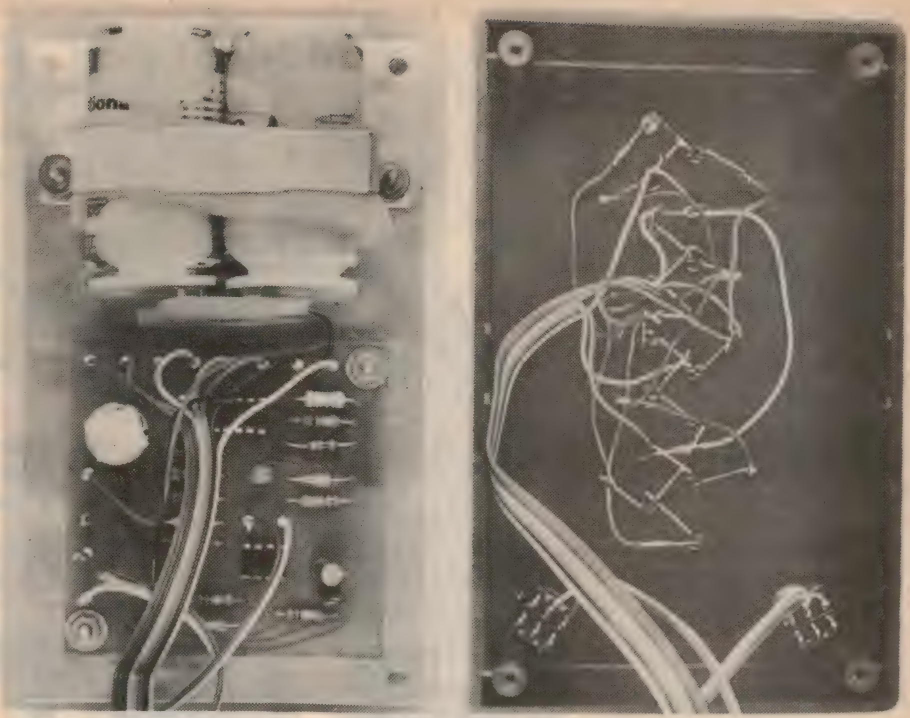
Although we stated earlier that the loading on the 470uF capacitor was negligible, this is not strictly so. The 1M and 390k resistors, in conjunction with the impedance presented by pin 11, as well as the leakage resistance of the electrolytic itself, combine to slowly discharge the capacitor. This discharge is most noticeable when the capacitor is highly charged, and accounts for the "slipping back" observed by our hypothetical player. This effect adds to the difficulty of the game.

The stabilised LED driving voltage is made available at pin 14, and is normally connected to pin 16 by a suitable resistor. We have included a transistor in series with a 10k resistor, and used the output of the 555 to switch the transistor on and off. This pulses the LEDs, eliminating the need for a separate flashing indicator.

As well as being economical in terms of components, this also means that a stabilised supply is not necessary. This is because the 555 and the UAA170 both use fractions of the supply voltage as their references, making frequency and comparator switching levels independent of supply variations. As the LEDs are driven from a constant voltage source, their intensity does not change with supply voltage either.

We have used eight 1.5V penlight cells to power the circuit, giving a nominal 12V supply. The batteries are mounted in two 4-way holders, as shown in the photographs. The average current drain of the complete circuit is about 25mA, giving an estimated life of 40 hours.

If required, it would be possible to fit a small transformer and rectifier/filter assembly in place of the batteries, although the initial cost would be much higher. The voltage applied to the circuit must be kept below 16V, to prevent damage to the ICs.



These two photographs give a clear picture of the internal construction, including details of how the LEDs are wired together.

Construction of the game is quite simple, as all major components except the LEDs are mounted on a printed circuit board (PCB). This measures 71 x 71 mm, and is coded 76g3. We recommend the use of PCB stakes for all external connections to the PCB. Fifteen are required.

We mounted the game in a standard plastic utility box, measuring 159 x 96 x 50mm, fitted with an aluminium lid. We used the box upside down, which necessitated filing off the moulded-in feet on the bottom. We made a front panel from photo-sensitive aluminium, and used this as a template for drilling the required holes for the LEDs and switches.

We expect that component suppliers will be able to supply suitable front panels. Alternatively, dyeline prints are available from our Information Service. These may be used to make bromide prints by the contact method.

The LEDs are simply pushed into suitable holes. If necessary, mounting clips can be used, or they may be simply glued in position. Arrange them so that the anodes and cathodes are all oriented in similar fashion, as this will facilitate wiring them up. If desired, the top LED can be a different colour, to signify success.

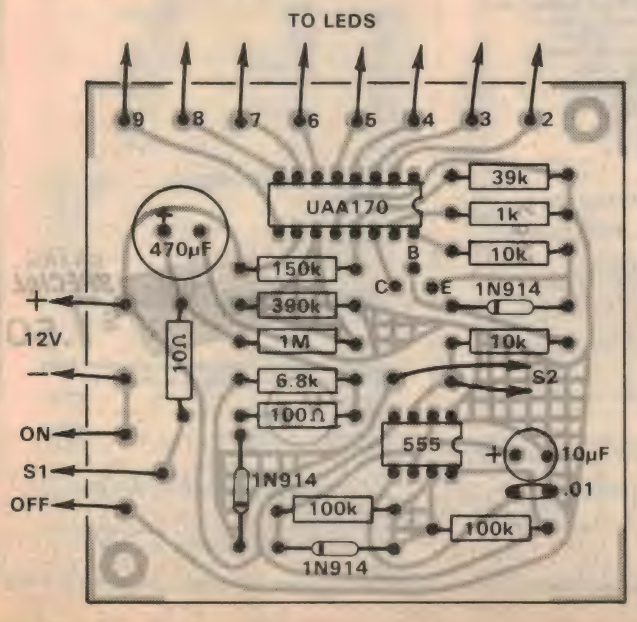
The choice of the switches poses a slight problem. Matching push-operated switches, such as we used, are obtainable, although they are expensive. If required, non-matching switches could be used, e.g., a slider type for the power switch, and an economy push-button for the climb switch.

The completed circuit board is fastened to the lid of the box using machine screws and nuts. The batteries are held in position with a small clamp fashioned from aluminium.

The wiring from the PCB to the LEDs and switches is best done with rainbow cable, as this makes for easy identification of the different leads. Complete the interconnections between the LEDs first, using the circuit diagram as a guide, and then connect them to the PCB.

Construction is then complete, and you can attempt to climb the ladder. If the LEDs do not come on in order, it is likely that the connections to them are in error. Any LEDs failing to emit will probably have anode and cathode transposed.

Once you have mastered the necessary skills, and can climb to the top of



The numbered connections at the top correspond to the pin numbers of the UAA170. Refer to the main circuit diagram for details of the wiring required to the LEDs.

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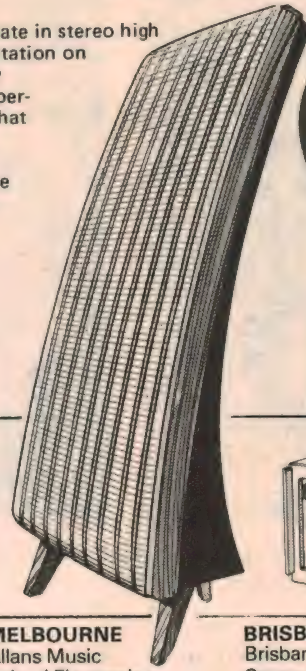

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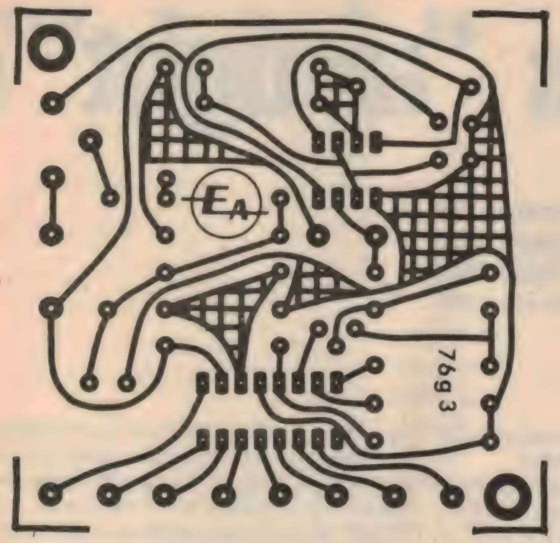
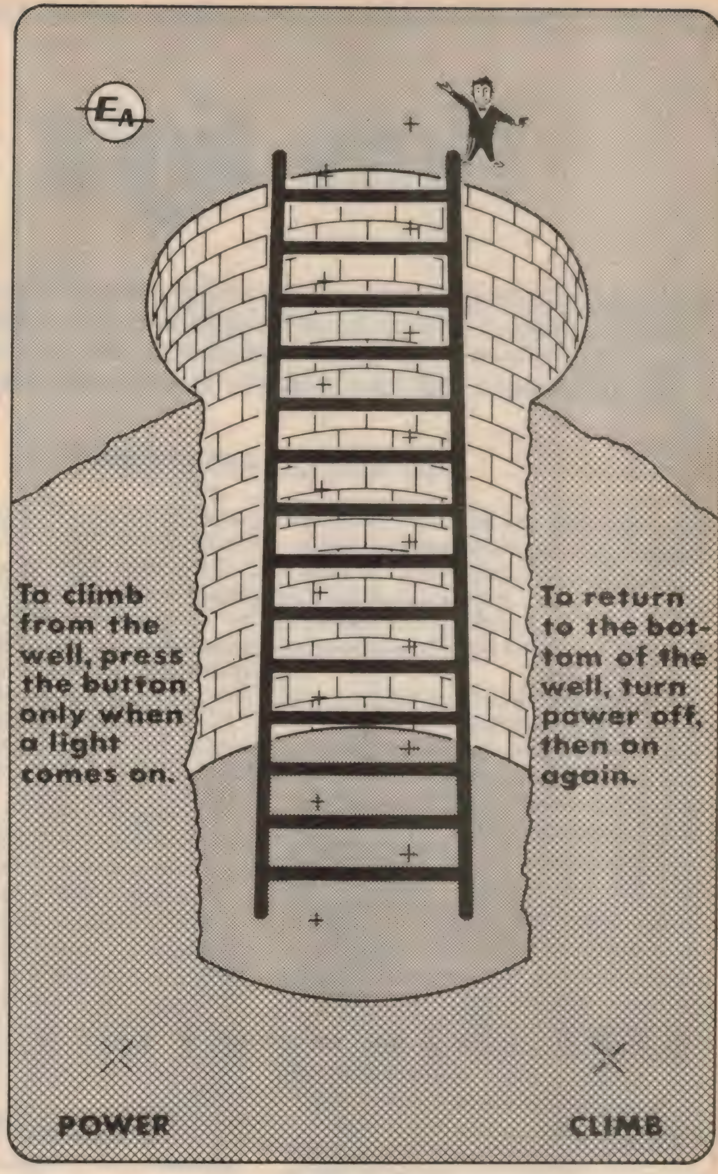
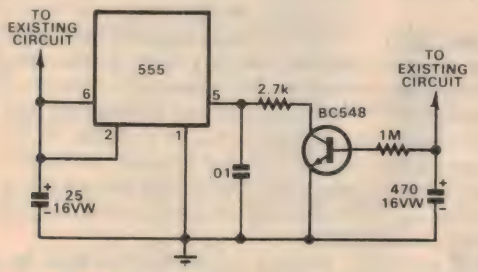




Shown above is the PCB pattern, while to the right is a reproduction of the front panel. These are both full size, and can be copied if desired.



A simple modification to the game, as shown above, can make it very much harder to reach the top of the ladder.

the ladder in a dozen or so steps, a small modification can be made to make the game even harder to beat. By adding a single transistor and two resistors, the circuit can be modified so that the flashing rate becomes dependent on the amount of charge in the 470uF capacitor.

The accompanying diagram shows how this is done. The BC548 transistor is used as a variable resistance, loading down the control input of the 555 timer. As the voltage on the 470uF capacitor rises, the bass current in the transistor increases, turning on the transistor.

This loads down pin 5, and changes the internal thresholds, so that the timing capacitor does not have to charge and discharge through the same voltage swing. This speeds the oscillator up, while maintaining the mark/space ratio at approximately unity.

Thus the LEDs turn on for shorter and shorter periods, making the task of climbing to the top of the ladder harder and harder as the climber approaches the top. The 1M base resistor serves to keep the transistor on the linear portion of its operating curve, while at the same time minimising loading.

The 2.7k resistor limits the maximum frequency of the 555. This value can be varied if required. With the value we have shown, we found that at the top of the ladder, the "on" pulses were a little too short for satisfactory operation, so we changed the 10uF timing capacitor to 25uF. This gave an acceptably wide "on" pulse, while still making the task of climbing the ladder suitably difficult.

No provision has been made on the PCB for these components. However, with a little care and ingenuity, they can be fitted to the pattern underneath the board. We will leave the exact details of this to individual constructors.

WHEN CONSIDERING LOUDSPEAKER ENCLOSURES . . .

How tight is "airtight"?

Almost as a matter of course, people who specify details of loudspeaker enclosures insist that they must be rigid and fully sealed against air leaks, apart from any deliberate vent or port. But just how important is this specification and how diligently should it be observed in practice?

by NEVILLE WILLIAMS

The question was asked in our recent Year Book and was answered in a matter-of-fact way—accurately but without any urgent conviction. Had we phrased the answer now, two or three months later, we might have been much more positive in our statements.

What happened in the meantime was that an engineer showed us the response curve he had plotted of an inexpensive, locally assembled vented system. The shape of the bass response caught our eye: Instead of holding more or less flat down to a discernable corner frequency, and then dropping away at something like 24dB/octave, it had a small hump at around 70Hz, followed by a slope to about 40Hz and a roll-off after that. It wasn't too bad a curve in terms of apparent response, but it was certainly not characteristic of the breed.

Thoroughly curious, we decided to take a closer look at the particular enclosure and were given a free hand to "have a go" at it.

Our first step was to plot an impedance curve—a much simpler procedure than measuring acoustic output but none-the-less indicative of what is going on. It is done by wiring a small value resistor (1 ohm or less) in series with the loudspeaker system and, while keeping the input to the speaker constant, measuring the voltage drop across the resistor with a millivoltmeter. By regarding this as proportional to the load current, it is possible to derive a figure for impedance relatively easily.

At 100Hz the impedance turned out to be 10 ohms—not at all an unlikely figure at this frequency for a nominal 8-ohm system. Below 100Hz, the impedance rose steeply to a broad peak embracing the 50-80Hz region and reaching about 30 ohms at between 60 and 70Hz. It then dropped to a trough of 18 ohms at 40Hz, climbing to another peak at about 28Hz. Superficially it was the classical shape of bass impedance curve except that the trough should have been about half the indicated value; in other words about 9 ohms!

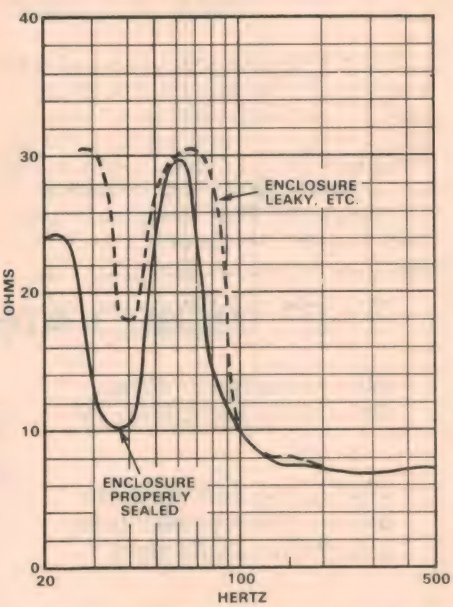
As a back-up exercise, we managed to get hold of the other system in the pair and ran a similar test. It yielded much the same curve but with an impedance at the enclosure resonance of 23 ohms!

The fact that the loudspeaker impedance looked like 18 and 23 ohms at the resonance of the system was an indication that the enclosures were not providing the proper acoustic load on the rear of the cone. Fairly obviously, the "Q" of both enclosures was much lower than it should have been, almost certainly accounting for the uncharacteristic acoustic output curve.

The hump at 70Hz would almost certainly be due to the resonance of the speaker itself in the confined enclosure.

What should happen below this region is that the port should contribute progressively more to the total acoustic output, radiating in phase with the loudspeaker. At enclosure resonance, output from the port is dominant and, ideally, sufficient to sustain the total response of the system at near reference.

At frequencies below enclosure resonance, output from the port exhibits a change in phase so that, while it is still quite high, it tends to cancel rather than reinforce radiation from the cone. As a result, the response of the overall system should be sustained down to the enclosure resonance, thereafter falling away at a nominal 24dB/octave.



The bass end impedance of an inexpensive vented system before and after sealing. The curve includes the resistance of crossover inductor and connecting leads.

In the system under inspection, the designer had obviously aimed for an enclosure resonance of about 40Hz, a common design target which should cope with the frequencies contained in the vast majority of program material. For reasons that remained to be discovered, the enclosure was doing only half a job, contributing some strength to the 40Hz region but not enough to hold it up to reference. Hence the output curve which tended to straggle downwards from 70Hz.

There is a corollary to this: At system resonance, where most of the output is coming from the port, the excursion of the loudspeaker cone is minimal. From this flows the ability of a well-designed vented system to produce a generous bass output with minimal stress on the driver and, hopefully, minimal distortion and Doppler effect on higher frequencies. If the enclosure does not do its job, the user either puts up with the loss of response, or works the bass boost and speaker harder in an effort to make up the difference.

As it happened, visual inspection of the enclosures showed nothing obviously amiss, nor was there any obvious leak when the system was driven hard at 40Hz. We did notice that the internal cladding—1-inch Innerbond—was stapled rather loosely to the walls and somewhat radiused around the rear corners. It seemed possible that, if the Innerbond was unnecessarily occupying free space in the enclosure, or significantly moving with the air flow, it could be adding a significant loss component.

For the rest, the corners of the timberwork appeared to be mitred, flush and glued. The back was rebated, pinned and presumably glued snugly in position and, though unsupported, did not appear to be drumming unduly. The baffle was not bedded into caulk or foam but appeared

to fit snugly and tightly against cleats. The mid-range enclosure looked airtight, the bass driver was screwed down against its cork washer, and the tweeter (again without caulking) fitted snugly against the baffle surface.

It was not bad—but obviously not good either!

While it may have been interesting to work methodically through every joint and surface in order to apportion blame, it would also have been very time consuming. As a result, we decided to give the enclosures the full treatment and see how they measured up after that.

The internal cladding was stripped out and a cleat glued and screwed across the rear panel to stiffen it and divide it into two dissimilar areas. Cracks where the cleats abutted were filled with caulking compound glue, as appropriate, and a knob of non-hardening caulking compound was pushed over the rear of the connecting socket on the rear panel.

Then the cabinets were tilted back at 45 degrees and a line of PVC glue laid in the angle formed by the floor and back panel, the cleat and back panel, and the front cleat and floor. The glue was worked into the angle with a screwdriver and left to soak in and set overnight. It formed a quite obvious seal against any possible leakage in the joints so treated.

It took several such operations, plus the elapsed hours to run PVC into all the angles but, with the job done, we were sure that the enclosures themselves were really airtight.

FIRMLY, THIS TIME

We then replaced the Innerbond but, this time, pinned it firmly back against the enclosure walls with a generous helping of upholstery tacks and drawing pins. In particular, we were careful to pin it down hard adjacent to the inner end of the vent tube. The vent tube itself was freed of any stray cardboard edges and for good measure, the ends were rounded with sandpaper and sealed with glue—this to silence any hisses which corners and fragments can cause when the tube is carrying high velocity air.

Next step was to obtain a 5-metre pack of ⅛-inch thich adhesive backed foam, which is available at most hardware stores as a draught excluder. (Engels No. 56.) This was located carefully along the cleats for the baffle to bed down against. A circle of the same material was also placed under the rim of the tweeter. The driver was left as it was, bedded down against its own cork gasket.

All this may sound like a rigmarole but it represents the difference between achieving an "airtight" condition or merely paying lip service to it. At the manufacturing stage the real thing will inevitably cost money, so that a "bargain" which merely looks the part may not be a bargain at all in the acoustic sense. Almost certainly it will need further attention along the lines indicated.

Did our efforts make a difference?

Repeating the impedance curves under precisely the same conditions yielded a much narrower impedance peak for the speaker itself, centred on 60Hz, and an enclosure resonance dip bottoming at 10 ohms or less at 38Hz, which we subsequently discovered to be the design target.

Unfortunately, the year-end holiday shut-down forestalled any chance of repeating the actual response measurements but, if theory means anything, the output should likewise have been sorted out.

Certainly, on listening tests with sinewave input, it was now smooth, solid and tight down to below 40Hz, with a corresponding bonus at the bass end of typical program material.

What comes out of this is plain enough. "Airtight" means exactly what it says in relation to a vented system, notwithstanding the presence of the port. And when the specification calls for lining to be pinned or glued firmly against the walls, it means "firmly". To disregard these matters is tantamount to setting up a critically tuned circuit, then carelessly wrecking it with resistive losses.

And what of fully sealed enclosures? Are they also critical?

Although it is not always realised, a practical sealed enclosure also relies on a resonance effect—that of the driver itself, stiffened by the enclosed air behind the cone and damped, in part by the output impedance of the driving amplifier, and in part by any filling material specified for the enclosure.

Assuming that there is some constraint on enclosure volume, an optimum design will guide the system resonance to a selected frequency, and damp it to about unity "Q". The response curve should extend, substantially flat, or with a slight hump, down to the resonant frequency, rolling off thereafter at a rate of about 12dB/octave.

But, take that carefully designed system and lower the "Q" by over-filling the enclosure, or permitting air leaks, and the "corner" will disappear from the carefully tailored bass response curve, leaving it to trail away in an indeterminate fashion. In addition, there is every chance that air passing through the cracks will add its own hiss to the total sound.

Once again, "airtight" means ... airtight!

In practical terms, we have seen nothing to suggest that higher quality and higher priced enclosures from hifi specialist centres are suspect. We are not nearly so confident about economy systems and the kind of thing often put together by do-it-yourselfers. If you have any doubts at all about your own system, don't trust to appearances: buy a tube of PVC glue and a pack of adhesive foam and make sure!

'Magic' table lamp uses low-cost Touch Switch.

A touch-controlled switch can be put to a variety of uses. In this article, we explain how to make such a device from economical parts, and then show how to incorporate this into an attractive table lamp.

by ROSS TESTER

When I was a boy, I made a table lamp. It was one of my first wood-work projects at school, and was my pride and joy. That was, until the teacher politely asked "How do you turn it off?" I had forgotten the switch—and it was almost impossible to fit one to it.

Just lately, I've made another lamp without a switch. At least, that's what it looks like—until you touch it. Surprise! It comes on. Touch it again, and it goes off.

All this has come about by means of a touch switch—one of those electronic toys which can be put to a large variety of uses, and not all of them trivial, either. You may have noticed many modern lifts have call buttons which do not need pressing—just touching. Some of the latest generation of colour television receivers similarly have channel selector buttons which are touched to call up the channel. Both these are examples of touch switches in action.

While the examples given are likely to be controlled by integrated circuits, it is just as easy (and often cheaper) to do the job with discrete components. For example, our touch switch circuit uses garden-variety transistors—we happened to use BC108s, but any small signal NPN transistor would do the job. And considering BC108s have been selling for as low as 5c each, and regularly for less than 20c each, this helps keep costs down.

In fact, practically all components in our touch switch could come from a well-stocked junk box. Even if you buy all new components, the touch switch circuitry shouldn't cost more than about seven to ten dollars (depending mainly on the cost of the transformer).

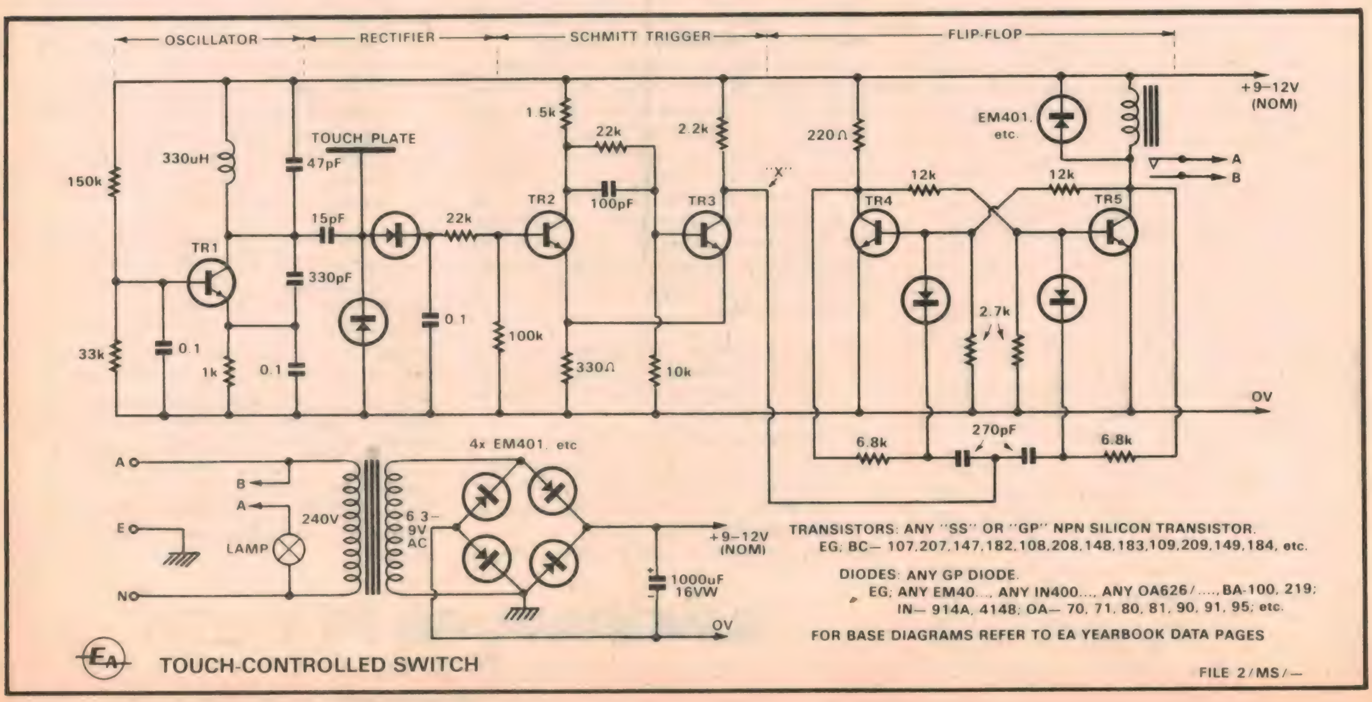
Before we go any further, we had better explain just how our touch switch works, and variations possible on the original. Actually, while they are called touch switches, most devices of this type are really proximity switches—that is, they work by something coming close to the touch plate or pad, but not necessarily touching it.

They do this because the body of the person attached to the hand or finger touching (or coming close to) the pad represents quite a large order of capacitance to ground—even though there is no physical connection between the body and ground. (No, Virginia, you don't have to stand in a flowerpot to make the thing work.)

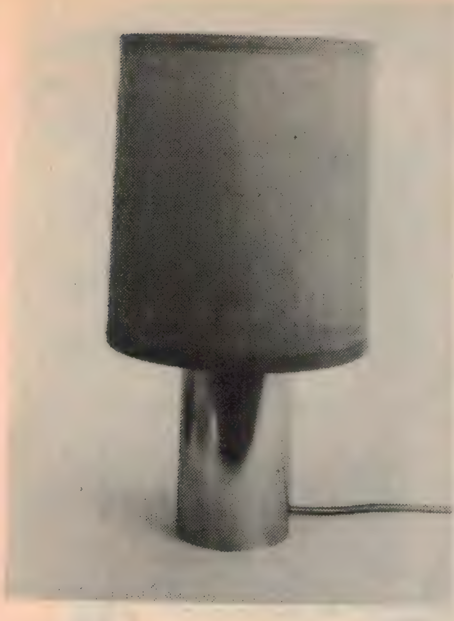
Turning our attention to the circuit, the first transistor is connected as a Colpitts RF oscillator, with a frequency somewhere around 400-500kHz. Actual frequency of operation is unimportant, so long as the frequency doesn't happen to be either 455kHz or above 530kHz, which could tend to make radio reception in the near vicinity a little difficult!

Assume, for a second, the touch plate is not being touched, nor is anything close to it. The output of the oscillator is fed via a voltage doubling rectifier to a Schmitt trigger, which is actually a level detector whose output changes very quickly between two states—high and low—as the input voltage passes a certain threshold.

Normally the Schmitt trigger sees a high input voltage, as this is the level at the output of the rectifier. However, when a hand touches, or comes close to, the touch plate, things begin to happen! The voltage doubler is fed via quite a low value of capacitance—in our case it was 15pF—which is easily swamped by the



TOUCH-CONTROLLED SWITCH



much larger capacity of the body.

In fact, the body and the input capacitor form a capacitive voltage divider —and in a capacitive voltage divider, where the capacitors are uneven in value, the greater voltage drop is across the smallest capacitor. It may be easier to visualise this by reference to Fig. 2. This shows two AC generators, one with a single C in series and one with a capacitive voltage divider across it.

In the first example, assuming negligible losses in the capacitor, the output voltage is the same as the generator voltage. In the second, the output voltage is less than the generator voltage, and if the top C is small with respect to the bottom C, the output is much less than the generator voltage.

So it is with the touch switch. The body represents the bottom C, and it is much larger than the top C. So the body robs the system of much of the energy which is being generated by the oscillator—so much, in fact, that the output of the voltage divider is negligible.

Take the hand away, and the system reverts to the conditions as in the first example. There is no longer a divider, only a series C, so the voltage doubler "sees" all of the output from the oscillator.

When the input to the Schmitt trigger is high, TR2 is forward biased, with its collector voltage quite low. It is too low, in fact, to enable TR3 to turn on, as its base is held at ⅓ the TR2 collector voltage by its base bias resistors. Therefore, TR3 is turned off and its collector voltage—and therefore the Schmitt trigger output—is high.

When the input goes low, TR2 is turned off, and its collector voltage goes high. This carries the base of TR3 high, and turns TR3 on. Its collector voltage then drops to a low voltage level, and so the output of the Schmitt trigger goes low.

Transition between the two states is very rapid as the Schmitt trigger passes the threshold in either direction, due to the large amount of feedback between the two transistors, assisted by the speedup capacitor across the 22k bias resistor.

So now we have a touch switch which has a very definite high and low output state—touch the plate and the output goes low instantly. Remove the hand and the output goes high instantly. Where do we go from here?

It depends on what you want the touch switch to do. If, for example, you want the touch switch to ring a bell when the plate is touched, a simple 1-transistor relay driver is all that is necessary. If you want the device to "latch up", this can be done quite simply with some of the relay contacts.

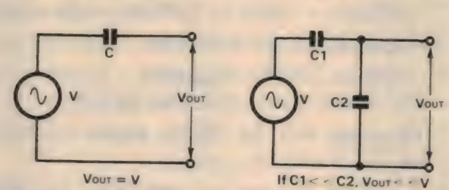


FIG.2

We have gone one better than both of these. By the addition of a flip-flop (bistable multivibrator), we can make the touch switch act as a true switch—touch it once and the switch turns on, touch it again and the switch turns off. An additional two transistors and a few minor components are all that are necessary to achieve this.

Referring back to the circuit diagram, transistors TR4 and TR5 are interconnected so that one's base is connected to the other's collector and vice versa. Therefore, only one of the two can turn on at any one time, as there will be no bias available for the one which is "off" because the collector of the one which is "on" will be low. However, if the "off" transistor is biased on by some external means this will force the previously conducting transistor off, by robbing it of its bias.

In practice, it is easier to force the conducting transistor off. This is done by means of a diode gate, which supplies a negative-going pulse to the conducting transistor base. If this negative-going pulse takes the base to less than 0.6V above the emitter, the transistor turns off, thus supplying bias to its partner.

The diodes ensure that only the conducting transistor receives this turn-off pulse, thus allowing the partner to conduct without any hindrance. So it can be seen that each time a negative-going pulse arrives at the gate, the diode steers it to the correct transistor and toggles the flip-flop. By making one of the collector loads a relay, we can actuate or deactuate it by supplying a pulse to the gate—and this is just what we do.

The Schmitt trigger output is normally high, and when the touch plate is touched, it goes low—that is, it is a negative going pulse. This is fed into the gate and so toggles the flip-flop. If the relay was closed, it now opens—and vice versa. In the interests of reliable triggering, we have made the collector loads equal—a 220 ohm 1W resistor matches the resistance of the relay coil. While this might appear wasteful of power, it assists the flip-flop by making both sides as equal as possible, so one side is not harder to toggle.

One might ask why use a relay at all—why not some other form of power control device which does not use as much power itself? The answer is safety. The touch switch is quite suitable for controlling mains loads (and we will say more about this in a moment) but, because you can actually touch the plate which is connected into the circuit, isolation is needed. A relay provides this isolation.

So now we have an on-off touch switch—what will we do with it? One use which immediately sprang to my mind is a touch-control bedlamp. Have you ever woken in the middle of the night with a baby screaming and tried to find that teeny weeny switch to turn the lamp on? (You're not married and have no kids—oh well . . .). How about when you want to get up at 4 am and you knock the lamp over trying to turn it on to see the time.

To make construction of a lamp as easy as possible, we elected to use a single length of extruded aluminium tube as the base, plugged each end with a 25mm thick disc of softwood. The electronics are mounted on the bottom disc inside the tube, while a ceiling-type lighting fixture screws to the outside of the top disc thus allowing a lampshade to be fixed.

The aluminium tube should not be too hard to acquire—especially if you have a specialist aluminium centre nearby. Ours came from The Aluminium Centre in Sydney Road, Balgowlah, who cut the tube to the size required. They informed

us that this is normal at most aluminium shops, as the aluminium is sold by the kilogram, so you pay for exactly what you get with no "fudge factor" for cutting from a longer length.

The tube diameter was as large as we could buy—100mm od, (approx. 93mm id) and approx. 200mm long. Length of the base is really a matter of personal preference, determined to a large extent by the type of lampshade to be fixed to it. If you have access to a lathe, the ends of the tube can be smoothed most easily. If not, a file will do the job, but it will take just a little longer.

The wooden disc "plugs" may cause a few problems for some readers. Ideally, they should be turned on a lathe for proper fit, but they can be cut using a coping saw and truing them with a rasp. They can also be turned on an electric drill. The bottom disc should be a tight fit—so tight, in fact, it needs to be belted in with a mallet. This is for appearance more than anything else—it saves having to put screw holes in the base of the tube where they can be seen.

The top plug can—and should—be a loose fit in the tube, as it is held in by screws which are normally hidden by the shade. If anything does go wrong with the touch switch, it is not too difficult a job to remove the top plug and hammer the bottom one out.

Incidentally, should you have a lathe at your disposal, don't be afraid to drill a hole through the centre of each plug—you will need to anyway. This can be up to about 12mm or so. It is easier to grip the wood from the centre using a bolt than to try to grip the outsides.

Once the plugs have been cut to size, the electronics can be fitted. The printed circuit board is attached with two right-angle brackets so it is vertical. It is important to maintain at least 5mm spacing between the edge of the PCB and the edge of the base plug—otherwise you risk a short to the metal cylinder. At best, this will stop the switch working; at worst, you will connect 240V to the cylinder. Need we say more?

(Just to be on the safe side, after assembling the PCB I covered all exposed mains connections and tracks with insulation tape before final assembly.)

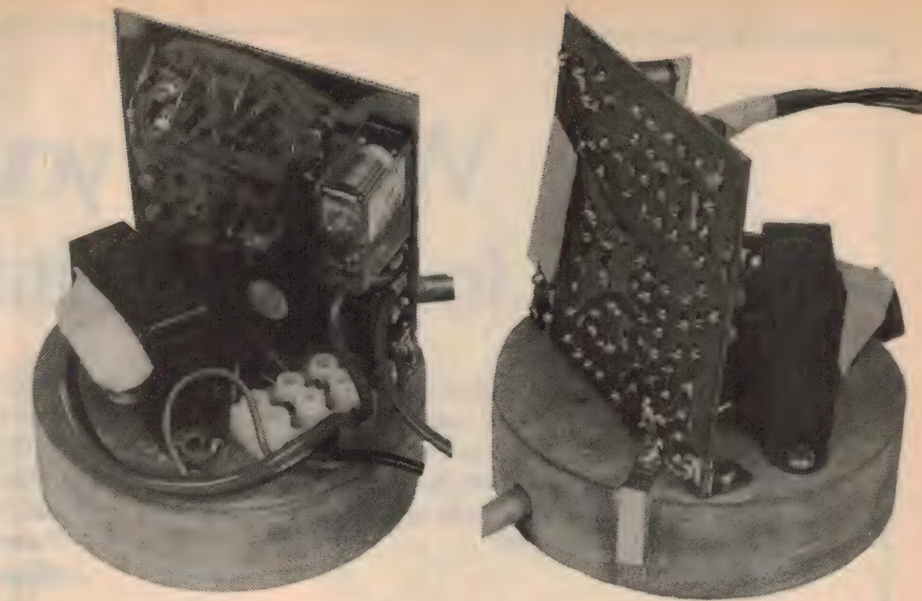
The connection between the PCB and the metal cylinder is best shown by the photograph. A strip of thin tinplate is used, which should be bent to the correct shape before soldering into place. Also, a channel is cut into the base plug to take this extra thickness. It must be deep enough to allow the base to slide into the tube, but shallow enough to ensure reliable contact between the tinplate and aluminium.

The channel can be tapered a little—deepest at the top, to achieve this aim. The edge of a file can be used as it does not have to be deep. Then the tinplate can be cut slightly narrower than the file to fit in the channel.

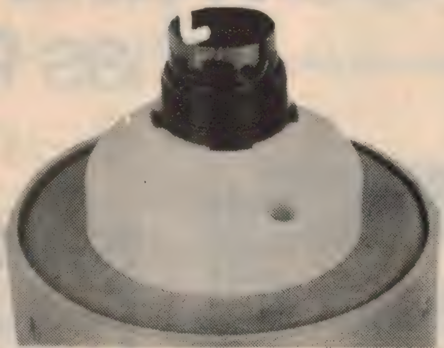
A single panel pin holds the tinplate in place on the base plug—don't rely on a solder joint to hold it. With the tinplate held in place, solder the end to the correct point on the back of the PCB.

The next step is to drill a hole through the side of the base for the mains lead to pass through. This can be done from just about any position around the circle, as the associated keyway in the aluminium tube can be drilled later to match it. The hole is drilled on a radius, about 12 mm up from the underside of the base, and about 6 mm in diameter.

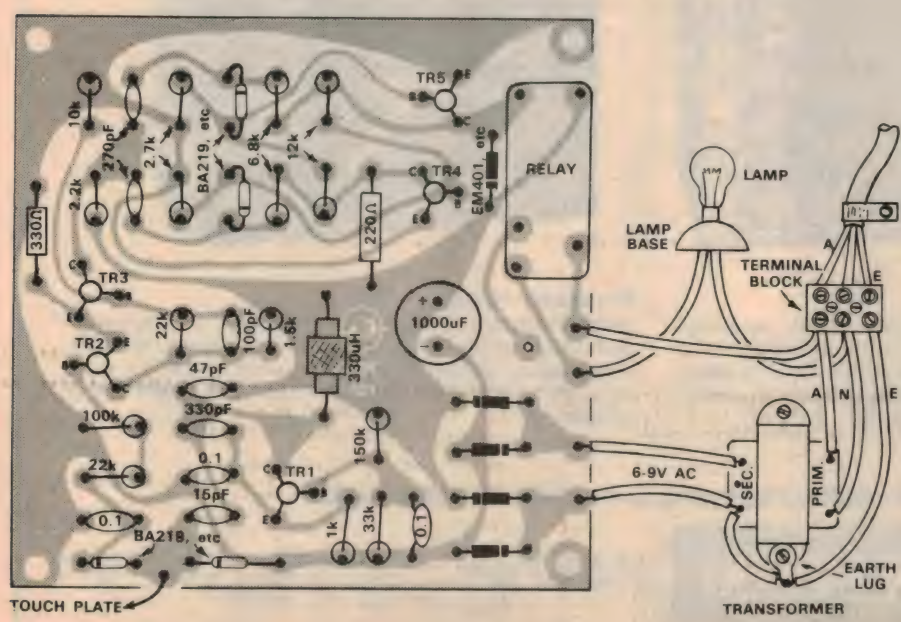
This hole mates with the one mentioned previously, that drilled through the centre of the wooden cylinder to assist turning. The incoming mains cord passes through both these holes, first the horizontal and then up through the vertical one to the "works".



The PCB, transformer and mains wiring mounted on the bottom "plug", shown front and rear. Note particularly the method of fixing the tinplate contact strip to the plug and PCB; also the insulation tape covering strategic (mains voltage) locations.



Above: The batten lamp holder, mounted on the loose-fitting top "plug", which in turn is held in place by three countersunk head woodscrews. Below: The component layout, shown on the PCB pattern, which is reproduced actual size to facilitate tracing.



The transformer and mains wiring can now be attended to. A 3 section mains terminal block holds the incoming mains wires and inter-connections to the transformer- refer to the wiring diagram for full details. A small mains cord clamp holds the lead itself.

The mains earth lead goes to the transformer case and also to one side of the transformer secondary. This is to try to cut down as much hum induction as possible.

Incidentally, some readers may wonder about the latitude allowed in the choice of transformer. On the circuit, we have specified a 6-9V secondary. The reason is that the circuit itself will happily work on supplies from around 6 to 18 or so. The relay, however, needs 8-12V DC to work correctly—and a transformer whose rectified voltage falls within these limits is quite satisfactory.

As it happens, the two transformers recommended are both centre tapped types. The 2851 is a 12.6V CT (in which case only half the secondary is used) while the 2840 is a 9V CT (ignore the CT on this one).

Remember when wiring the mains section that you are dealing with a device which people touch—your wiring must be exemplary. With correct wiring, this device is quite safe. But if you boo-boo . . .

The wiring of the light socket is best left until last—both for safety reasons and because the leads should be cut as short as possible for hum induction reasons—and this is not possible until both plugs are in position. The checking operations to be described can be carried out by listening to relay operation—either a single click for correct operation or "chatter" or no sound for incorrect operation.

Now comes the curly part—matching the switch to the cylinder! Perhaps a word of explanation is in order. Remember how the switch works—capacitor action dividing the voltage when the plate was touched. Unfortunately, this is exactly what the cylinder is—a "body" attached to the touch plate. In fact, this can cause the switch to lock on or off, as it sees a load on its touch plate at all times.

For this reason, a small amount of juggling of the coupling capacitor might be necessary. We found that the value shown, 15pF, was exactly right for our tube—but it may not be right for other lengths of tube. So it must be checked, and the easiest way to do this is to lower the tube onto the base just far enough to contact the tinplate strip, and see if it works when you touch it. If it doesn't work at all, or breaks into "chatter", the value has to change. Go up if it chatters, down if it doesn't work at all.

As a guess, the outside limits would be about 10pF to 25pF. The lower you go, the more sensitive it becomes, but also is more sensitive to hum fields—hence the chatter. And vice-versa, of course. Even with the optimum value of capacitor in our version (chosen by trial and error) we were still able to make the thing chatter by cheating. If the whole flat of the hand was brought in close to the cylinder and held there, the relay would chatter—but this is not the correct way of using it, so we weren't too concerned. A single touch is all that is necessary.

By the way, if you are not planning on making the touch switch in the lampshade form but wish to use it for some other purpose, it may interest you to know that the lower you make the capacitor the more like a true "proximity

ALL THE PARTS YOU WILL NEED . . .

1 printed circuit board, 77 x 77mm, code 76/s3
5 small signal NPN transistors (BC108, BC548 or similar)
4 small signal diodes, (BA219 or similar)
5 1A power diodes (EM401, OA626 or similar)

RESISTORS (¼ or ½W 5% except where shown)
1 x 220ohm 1W, 1 x 330ohm, 1 x 1k, 1 x 1.5k, 1 x 2.2k, 2 x 2.7k, 2 x 6.8k, 1 x 10k, 2 x 12k, 2 x 22k, 1 x 33k, 1 x 100k, 1 x 150k

CAPACITORS (LV, Ceramic or poly)
1 x 15pF, 1 x 47pF, 1 x 100pF, 2 x 270pF, 1 x 330pF, 3 x 0.1uF, 1 x 1000uF 12VW PC electro.
1 x SP C/O relay, PCB mounting, coil approx. 250 ohms
1 x 330uH (approx.) RF choke
1 x power transformer, sec. 6-9V at 100mA (+), miniature type, PF2851, M2840, etc.

ADDITIONAL PARTS REQUIRED FOR LAMP
1 x 100mm dia. aluminium tube, 200mm long
2 x wooden discs, approx. 25mm thick x 100mm dia. (see text)
1 x bc lamp batten holder, HPM 366P, Ring Grip BH1 or equivalent
1 x shade to suit base.

MISCELLANEOUS
Mains cord (3-wire, ANE) and plug, mains cord clamp, figure 8 lead (for internal mains wiring) 3-way mains terminal block, solder lugs, tinplate scrap, woodscrews (8 in all, 3 with csk heads), solder, etc.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used, providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.

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Sign Painting and Designing
Advertising Layout and Illustration

Motor Mechanic
Motor Mechanic
Institute of Automotive Mechanical Engineers — General Craftsman & Associate Member
Queensland "A" Grade Motor Mechanic
Queensland "B" Grade Motor Mechanic
Victorian Automobile Chamber of Commerce — Senior Motor Mechanic or "A" Grade Certificate
Basic Motor Engineering
Automatic Transmission Specialist
Automobile Engine Tune-Up
Automobile Electrician
Driver's Maintenance
Panel Beating and Spray Painting
High Speed Diesel Engines

Building and Architecture
Building Contractor
Building Sciences
Quantity Surveyor
Building Supervisor
Clerk of Works
Architectural Assistant
Carpentry and Joinery
Builders Draftsmen and Plan Drawing
Basic Building
Carpentry
Bricklaying
Plumbing

Modern Management
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Commercial Education Soc. of Aust. — Diploma in Management
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Works Management
Office Management
Personnel Management
Small Business Owners
Modern Marketing Management
Modern Supervision
Stores Supervision
Purchasing and Supply Management
Club Management
Modern Management

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Advertising Institute of Australia — Complete Program
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Sales Management
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Company Representative
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Stenography
Clerk-Typist
Gregg Shorthand with Speed Building
Gregg Speed Building
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TV Service Technician
Television Principles
Television Engineering
Television Servicing

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Professional Writing
Short Story Writing
Freelance Journalism
Script Writing
Copy Writing
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Typewriting

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Electronic Technology
Electronic Maintenance
Radio and Electronic Telemetry
Electric Motor Repair and Servicing

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Mechanical Engineering Technology
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Hydraulic and Pneumatic Power
Boiler Inspector
Boiler Attendant

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Civil Engineering
Surveying and Mapping
Structural and Concrete Engineering
Structural Engineering
Overseer of Works

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Electrical Engineering
Electric Motor Repair and Servicing
Industrial Electrician
Electrical Mechanic

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Hotel/Motel Management
Club Management
Financial Management for Hotels and Motels
Hotel/Motel Owner

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Heating, Ventilation, Air Conditioning, Refrigeration Technology
Air Conditioning and Refrigeration Technology
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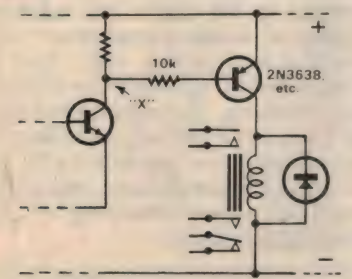
detector" it becomes. In fact, with a value of 1pF and a small touch plate, it will actuate from at least 20 mm away and more. But this only holds where the mains hum field can be kept away.

Once you are sure the switch is working correctly, pull the base out of the tube and connect the "lamp" leads to the terminal block and PCB. Note the relay is in the active side of the line, following normal mains wiring practice.

Now we are almost ready for final assembly. First of all, a keyway has to be cut in the tube for the mains cord. This can be done with a 6 mm drill, drilled about 10 mm from the bottom of the tube. Open it out to a slot with a file, taking care not to mar the appearance.

The three holes to hold the top plug can also be drilled. Divide the circle into three (remember the "flower" pattern you used to draw at school with a compass—this accurately divides a circle into 6—and so 3), and drill the holes to suit the size of screw you are using. The best type is a countersunk head, nickel plated, around one inch long and a fairly small gauge.



This one transistor relay driver may be substituted for the flip-flop for "on when touched" operation. Extra relay contacts could be used to latch on. Point "X" corresponds to point "X" on the main circuit diagram, immediately after TR3.

The holes can be drilled about 10mm down from the top of the plug. While you're about it, drill a pilot hole to match the holes in the aluminium—this will assist in final assembly. Remember to use a smaller drill, though! Remove the plug, and countersink the holes as necessary.

Now is the time to place the bottom plug in position. Carefully line up the mains cord keyway and the mains cord emerging from the base, and push the base hard down into the tube. If it is a proper fit, you won't get very far before you have to use a hammer and block of wood to keep it going. Don't belt the base too hard, take it in small "bites" working around the circle. Stop when the base is just proud (1-2mm) of the aluminium. This allows the lamp to rest on wood, rather than on aluminium.

The light fixture can now be screwed to the plug top. If you examine the fixture itself, you will note that the socket can be removed from the base by pushing it out from the front. It can be replaced from the front by turning it so the catches on the socket can pass through the slots in the base. A turn of a few degrees will then place the catches behind their counterpart on the base and the ring can then be screwed on to make it captive.

Separate the two halves of the socket, and screw the base into the middle of the top plug. Make sure you are exact here, as any error will appear amplified when you place a shade on. With the socket firmly on the wood, pull the lamp leads up through the tube and through the hole in the plug. Now push the plug down into the tube so it is 20mm or so down from the top.

Pull the lamp leads fairly tight, and cut them off so there is approx. 20mm protruding from the tube. Bare them back 5mm, and screw them into their positions on the socket. A normal socket has three holes—use the two outside ones. Now pull the top plug back up, and loosely fasten it in place with the woodscrews.

Push the socket into position on its base (as just described) noting how much slack there is in the leads. If there is too much, and the leads go too close to the tube, hum troubles may result, as we found. Ideally, the mains leads should pass directly up the centre of the tube. If there is too much slack, repeat the last couple of steps until there is as little slack as you can handle. Then screw the ring onto the socket to tighten it up.

If the ring keeps turning and the socket comes out of its base, you haven't turned the socket so the catches engage. Release the ring and turn the socket around slightly—then re-tighten. Last of all, do up the screws on the side and the lamp is finished.

As a final check, place an ohm-meter (1) across the lamp socket terminals; (2) between each of the terminals and the barrel of the lamp; (3) between each of the mains plug pins and the barrel of the lamp. If there is a reading between any of these, something is wrong and should be checked before use.

The lampshade is left up to the individual. They may be bought quite readily, or may be made from parts obtained at specialist shops. Either way, choose one which is not too small—it will look odd because of the "chunkiness" of the base—nor one too large, which may promote instability even though the base is quite heavy.

Lamp wattage is as suited to the shade bought—the relay has a 5 amp (1200W) rating, so there are no problems there.

And that's about all there is to it. Remember the touch switch applications are limited only by your imagination and the relay rating!

By the way, if you want something to keep a toddler amused for hours, show them how to use the touch lamp—just once. My one year old thinks she's the ant's pants: on off on off on off . . .

The only trouble is, the perplexed look when she touches a similar looking conventional lamp and it doesn't work!

Crystal-locked converter for the LF and VLF bands

Discover for yourself the mysteries of the normally inaccessible low and very-low frequency radio bands, with this easy to build solid state converter. Battery powered and low in cost, it will operate with almost any conventional short wave receiver.

by IAN POGSON

Have you ever wondered what signals there are in the frequency range below the broadcast band? Most of us have just a vague idea that there is a maritime distress frequency on 500kHz, together with the standard receiver intermediate frequency on 455kHz. Apart from that who knows?

The real old timers know that in the early days of radio, most of the activity was on the low frequencies, having wavelengths in thousands of metres. This is true, but what of the present time? The best way to find out is actually to have a listen for yourself. To this end, a converter is required and we have developed a fairly simple one which may be connected ahead of any suitable short wave receiver.

In developing a converter for low and very-low frequencies we adopted the philosophy that it should be as simple as possible, but capable of doing the job reasonably well. It should also be possible to feed it into a wide variety of receivers capable of tuning at least part of the short wave bands.

The basic converter consists essentially of an untuned RF amplifier with a ring mixer and a crystal oscillator. We chose a crystal on 7.5MHz and this is fed into the mixer. Signals below say 500kHz will be amplified and these are also fed into the mixer where they are mixed with the crystal frequency resulting in sum and difference frequencies. These will appear as "sidebands" on each side of 7.5MHz.

By feeding the output of the converter into a receiver capable of tuning to 7.5MHz and either 500kHz above or below, then a received signal on say 200kHz may be tuned in at either 7.3MHz or 7.7MHz, and so on.

From this it may be seen that it is possible for the converter to bring in signals down to very low frequencies indeed, limited only by the selectivity of the main receiver, which will be required to separate the wanted signal from the crystal signal which will appear right on 7.5MHz. For this reason we have used the double balanced ring mixer.

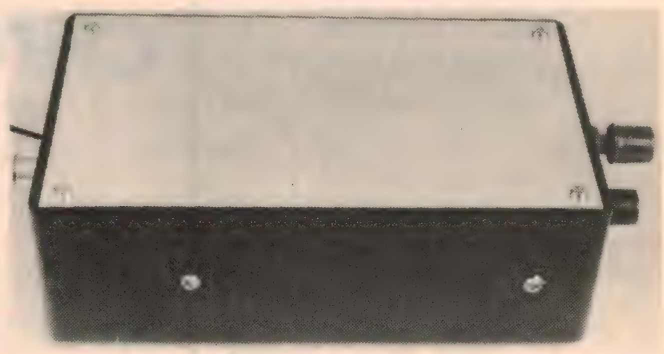
This mixer is theoretically balanced but due to characteristics of components, this is not normally achieved in practice with the basic circuit. A much better balance can be achieved by adding an adjustable potentiometer and a capacitor, which we have done. By these means, it is possible to reduce very considerably the strength of the crystal as tuned in on the receiver, and this allows us to tune even lower frequencies.

As the input to the RF amplifier is not tuned and in order to avoid strong local broadcast stations from causing unwanted interference and worse, there is a low pass filter between the aerial input and the base of the RF amplifier. This filter substantially reduces the ingress of any signals above 500kHz, and this also sets the upper limit to which the converter can be used.

At this point I should mention that although I have used a crystal on 7.5MHz, this is not mandatory and crystals over quite a wide range may be used. The oscillator circuit will accommodate crystals between about 2MHz and 12MHz or so. When selecting a crystal it is well to keep in mind that it is easier to use one which is on an integral number of MHz, with the next best one on a multiple of 100kHz. This makes it easier to determine from the main receiver dial calibrations as to the actual frequency of the signal being received. If you use a very "odd" crystal frequency, you will be involved in a mental calculation every time you want to work out the frequency of the LF signal.

A look at the circuit diagram will show how all this has been done. Immediately following the aerial terminal is a low pass filter consisting of a 2.5mH RF choke and a .0018uF capacitor. A link is shown immediately following and more will be said about this later on. A BC548 transistor is shown as a conventional amplifier with a multiple collector load consisting of a 2.5mH RF choke and a 4.7k resistor. This stage is followed by an emitter follower to transform from a relatively high impedance to a low impedance into the ring mixer which follows.

As the input of the mixer has to handle frequencies which are for all practical purposes in the audio and supersonic ranges, an audio transformer with a laminated iron core is used. Four germanium diodes, type OA91 or similar are used for mixing. The output transformer, which has to handle only high frequency components is one wound on a TV balun core. A 2.2k potentiometer and a 6-60pF trimmer are added to the mixer circuit for balancing purposes.

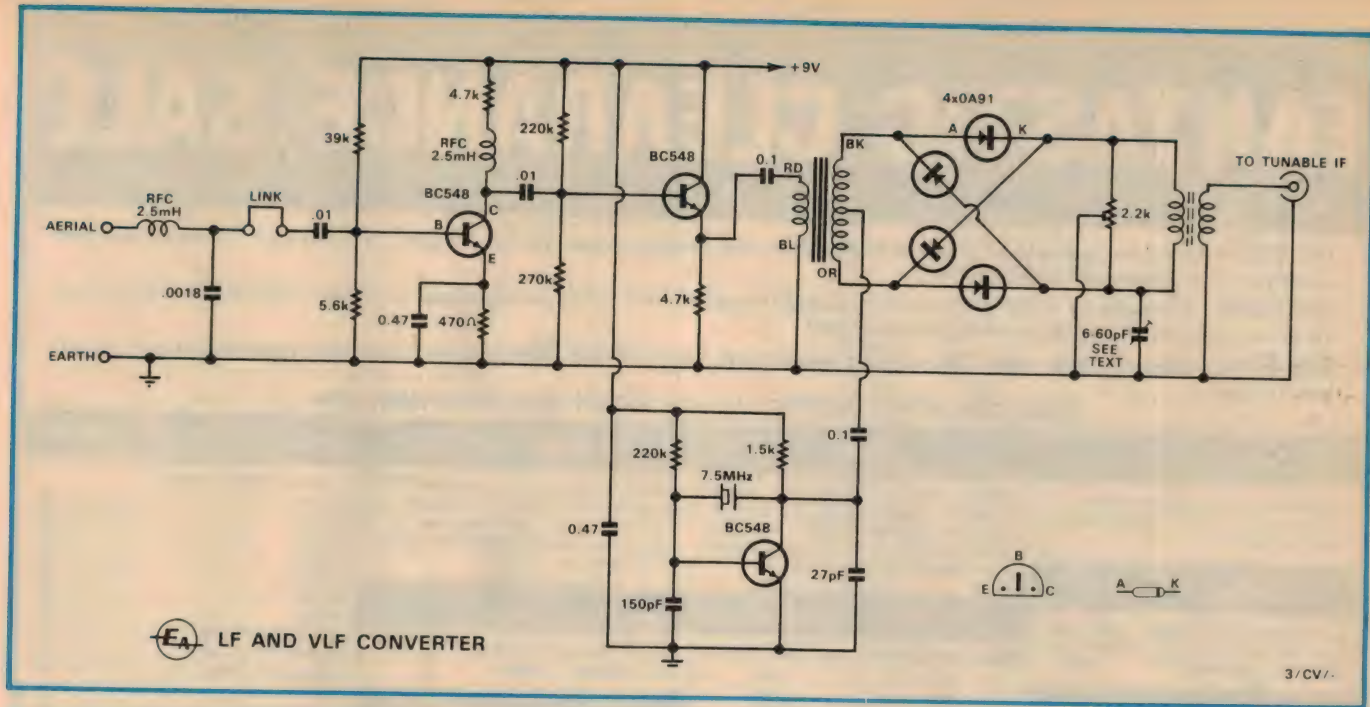


The completed prototype. Output is via a coax socket mounted on one end, with the aerial and earth terminals at the other end.

Another BC548 transistor is used in a simple Pierce crystal oscillator circuit. The oscillator output is fed into the centre tap of the mixer input transformer. The oscillator circuit should function satisfactorily over a wide frequency range without change in circuit constants.

Output from the converter is taken from the secondary of the output transformer of the mixer and this is fed into the aerial terminal of the short wave receiver.

Obtaining components for the converter should not present any problems but a few comments about some of the items may be helpful. The converter is built into a moulded plastic box with an aluminium lid. The box measures 150mm x 90mm x 50mm and is designated UB1, being available through Dick Smith Elec-



LF AND VLF CONVERTER

tronics Pty Ltd, either directly or through your local supplier. The iron cored transformer is type TRD223 and is made by Ferguson Transformers; it too should be obtainable through your local supplier.

The crystal is an item which is left very largely to the discretion of the builder. It may be possible to salvage one from your junk box or alternatively to get one from disposals sources. The old type in the FT234 holder is suitable provided that the frequency available meets your requirements. On the other hand, there are manufacturers such as Bright Star Crystals who will grind one to the frequency of your choice. We suggest that it be ordered by quoting the frequency required, HC-6/U, 30pF, ambient temperature and tolerance .003%.

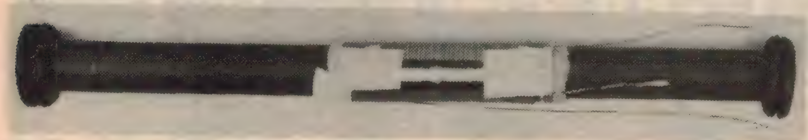
The transistors may be the new BC548, or they may be the older BC108, or the cheaper "gold-top" package type BC208, or equivalents of these types. The diodes may be the type specified or almost any germanium type would be satisfactory. All of the other components should present no problems.

As mentioned before, we built our converter into a moulded box but this is not critical and if you have access to another box which will accommodate the components, then this could be used. Also, as the device is so simple and to keep costs down, we have not used a PCB. Most of the components have been mounted on miniature tag wiring board instead.

As may be seen from the photograph, we used two boards, each with 16 pairs of tags, to mount the components. One board was used for the RF amplifier, including the input low pass filter and emitter follower. The other board accommodates the crystal oscillator and ring mixer. It may be noted that we did not use all of the tags available and if you wish, there is no reason why you should not use shorter boards.

We have provided wiring diagrams for the two boards and this should make the job of wiring quite easy. The general layout is not very critical and you may use your own layout and method of wiring, provided that you do it so as not to run into any instability troubles. It will be necessary to wind the mixer output transformer before it can be fitted to its board. To wind the transformer, take two lengths of 28B&S enamel wire and twist them together to a pitch of about 6mm. Wind ten turns, each turn consisting of a pass through each hole in the transformer core. The finished transformer

Crystal-locked converter



The input to the RF amplifier can be tuned by means of loopstick aerial and a variable capacitor. Details are given in the text.

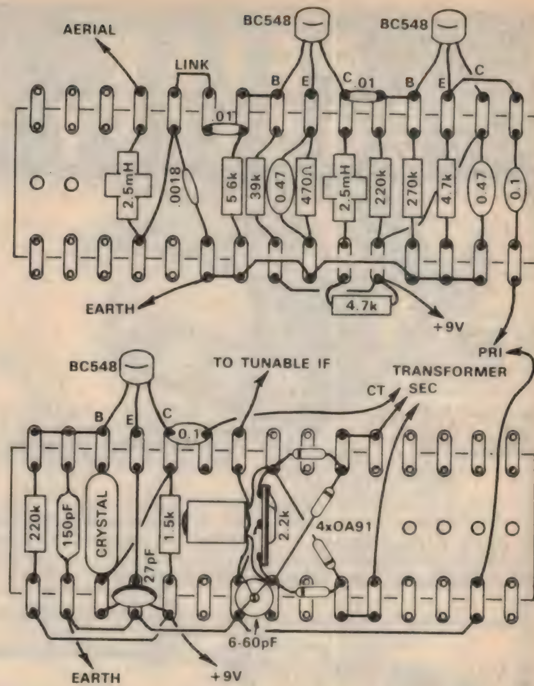
may be glued to the board during the wiring process.

Having wired the boards, it may be a good idea to wire them and the iron cored transformer together temporarily to make sure that they do work before fixing them permanently into the box.

To do this, you will need a battery or other power supply capable of delivering 9V at a few milliamps, a suitable LF aerial, and a receiver capable of being tuned to the crystal frequency and up to 500kHz above or below it.

The aerial may be a random piece of wire about 15m long and preferably outside and elevated, but more will be said about possible aerials later on. When connecting the output of the converter to the receiver it should preferably be done via a short length of coaxial cable. For the time being, set the mixer balancing pot and capacitor to mid position. With all made ready, carefully tune the main receiver for signals. You will be most likely at this stage to be more successful by tuning between 200kHz and 400kHz away from the crystal frequency. Within the range between the frequencies just quoted there are a number of aircraft beacons which are usually identified by a Morse code signal.

Later on I will give a list of stations which I have logged on this converter in the Sydney area. Meanwhile, assuming that you have received one or more of these signals, you are now in a position to fit the converter into its case and make final adjustments.



At right are the wiring diagrams for the two tagstrip sub-assemblies. The top board accommodates the RF amplifier, while the bottom board holds the crystal oscillator and ring mixer.

As may be seen from the photograph, we have fitted a board to each side of the box, with the iron cored transformer screwed to the bottom of the case and mounted close to the rest of the mixer. A coax socket is mounted at one end to take the output lead and two terminals are mounted at the other end, one each for the aerial and an earth if required. We ran an earth lead from a solder lug on the coax socket to each of the boards. Two leads for the 9V supply are connected to the board near the crystal oscillator and are run through a hole drilled in the end of the box near the coax socket. These two leads are also extended from the board across to the other one and near to the input of the RF stage. From nearby an aerial and earth lead are each run to the respective terminals at the end of the case.

With all the wiring completed, the converter is again connected to the receiver and the receiver is tuned to the crystal frequency. If you have a signal strength meter on the receiver, it will no doubt be reading full scale and the meter will help considerably in balancing the mixer. If you do not have a meter, then you can try to adjust the balancing controls, or just leave them set as before.

The process of adjusting a ring mixer for balance is generally quite an exacting procedure and it must be undertaken with considerable care. Try rotating the pot first, either for a sign of a fall in the meter reading or a rise in noise from the loudspeaker. Set the pot precisely for either of these indications. Now try slowly adjusting the trimmer capacitor for a similar effect. If you can rotate the trimmer throughout its range without making much difference to the balance, then the trimmer is on the wrong side of the mixer. The best thing to do is to reverse the connections from each transformer, the secondary of the input transformer and the primary of the output transformer.

Now continue the process of adjusting the capacitor for minimum meter reading or maximum noise and then try the pot again. Repeat these adjustments until you have the minimum possible meter reading or maximum noise. You will find that the procedure is most exacting and it can drive you "up the wall" if you try to get the ultimate from it. Generally, all

LIST OF COMPONENT PARTS

- *1 Utility case, 150mm x 90mm x 50mm, type UB1 (Dick Smith)*
- *1 Transformer, Ferguson type TRD223 or similar*
- *1 Balun core, Neosid type 1050/1/F14*
- *1 Crystal, selected frequency, HC-6/U, 30pF, ambient temp, tol .003%*
- *1 Socket for crystal*
- *2 2.5mH RF chokes*
- *2 Terminals, 1-red 1-black*
- *1 Coaxial socket*
- *4 Diodes, OA91 or similar*
- *3 Transistors, BC548, BC108, BC208 or similar*
- *2 Miniature tag boards with 16 prs tags*

Capacitors

- *1 27pF NPO ceramic*
- *1 6-60pF Philips trimmer*
- *1 150pF 630V polystyrene*
- *1 .0018uF low voltage greencap*
- *2 .01uF low voltage greencap*
- *2 0.1uF low voltage greencap*
- *2 0.47uF low voltage greencap*

Resistors (½W or ¼W unless stated otherwise)

1 470 ohms	*1 5.6k*
1 1.5k	*1 39k*
1 2.2k trimpot	*2 220k*
2 4.7k	*1 270k*

Sundries

Screws, Nuts, hookup wire, solder lugs

Note: Resistor wattage ratings and capacitor voltage ratings are those used on the prototype. Components with higher ratings may generally be used, providing they are physically compatible. Components with lower ratings may also be used in some cases if available, providing ratings are not exceeded.

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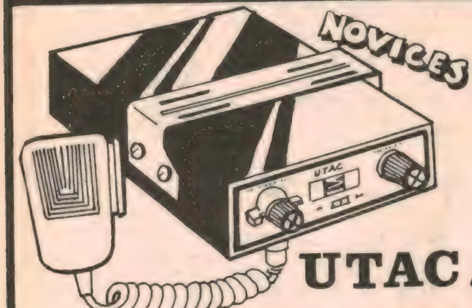

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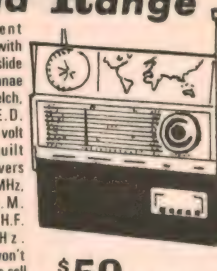

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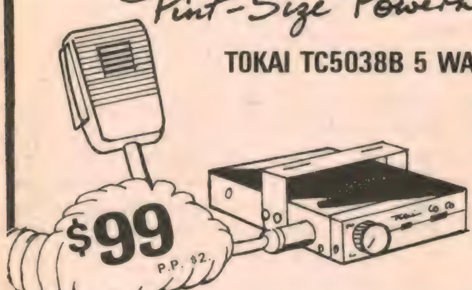

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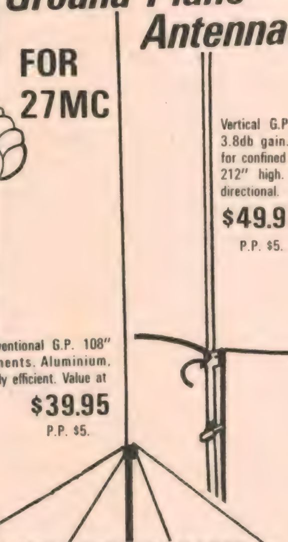

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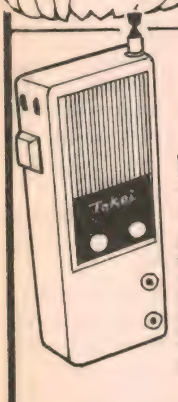

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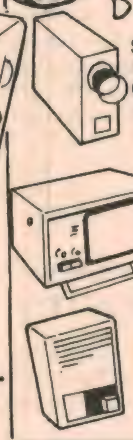

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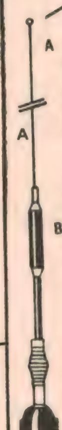

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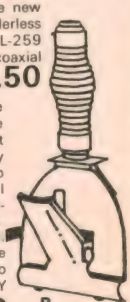

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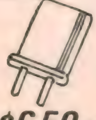

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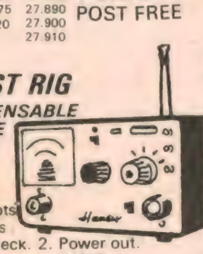

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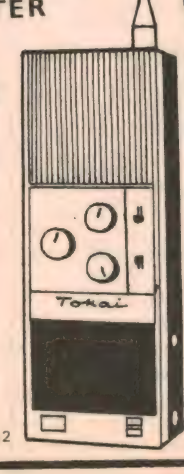

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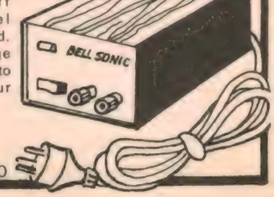

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Converter

one can do is to get the best possible null and then leave it at that. After all, it is not of vital importance. It simply allows you to tune closer to the crystal frequency, corresponding to a very low received frequency, possibly 10kHz or even lower.

At this stage, your low frequency converter is ready for use and it is up to you to explore this part of the spectrum as you see fit. There seems to me to be plenty of scope for experimenting with aerials, in particular.

After listening for some time, you may find that your interest may settle on one specific frequency or band of frequencies. Also, you may notice that the amount of noise heard on these frequencies is very high. To increase the efficiency with regard to being able to tune in some specific frequencies and to reduce the noise as well, it is possible to tune the input to the RF amplifier. You may recall that early in the description of the circuit there was reference to a link between the input low pass filter and the RF amplifier. The link may be removed and a tuned aerial circuit may be connected instead.

The tuned circuit consists of a ferrite rod loopstick, commonly used on present day broadcast receivers, and an ordinary 3-gang variable capacitor. We used a Roblan gang with each of the 415pF sections connected in parallel and the coil was wound on a ferrite rod which we happened to have about at the time. The rod is 200mm long and 12mm in diameter. If you can get one this size then well and good, but the more commonly available rods are more like 9mm in diameter and may be somewhat shorter. However, so long as it is not one of the very small ones, good results may be obtained.

It will depend very much upon the frequency range which you want to tune, as to the winding details for the coil. Each individual requirement will have to be treated accordingly but a few details of some windings may give some ideas as to where to start for any particular case. Here are some examples.

To tune from 100kHz to 300kHz, we wound a coil consisting of 100 turns of 30B&S enamel wire, tapped at 6 turns from the earthy end. Rather than count the turns, if you neatly close wind the coil and make it 2in or 51mm long, then that will be close enough. To tune from about 40kHz to 100kHz, a winding consisting of two 100 turn layers was required. A tap was made at 12 turns from the earthy end and a piece of paper was added in between the layers. A winding consisting of five 100 turn layers and tapped at 30 turns and with 560pF across it will resonate at about 22kHz.

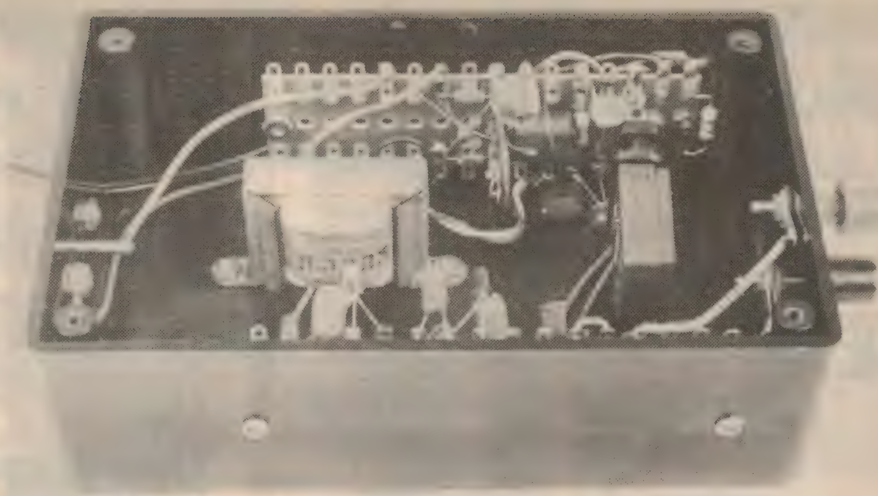
Having made up your coil, the question arises as to how best to arrange the coil and gang mechanically. The loopstick coil is directional and should be rotatable, while the gang should best be fixed. The coil may be separated from the gang by say a piece of figure 8 twin flex up to about 1m long. This will allow the loopstick to be rotated conveniently. Another similar flex may then be run between the earthy end and the tap, to the earth connection on the converter and the .01uF capacitor before the base of the RF amplifier.

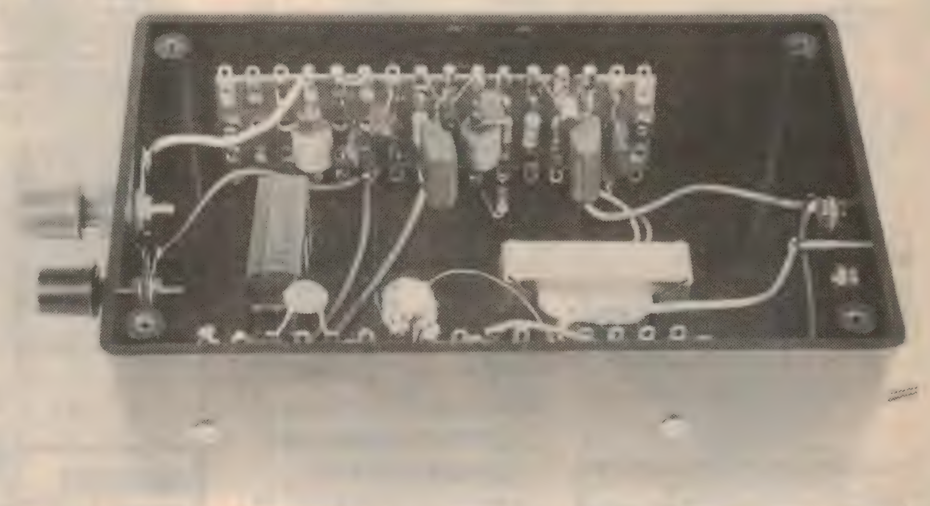
With the tuning arrangement completed, you will find that some skill is required to tune in the low frequency stations. In addition to tuning the short wave receiver as before, it will also be necessary to keep the front end tuned circuit manually in line with the main tuning. This is not quite as difficult as it may first appear because it is quite easy to peak up the front end tuned circuit on noise. Care is needed in the first instance but once a station is logged, it may be recorded on a suitable dial provided for the purpose. In addition to the above procedures, it is also necessary to rotate the loopstick and peak it on the station.

To give you some idea as to what to look for at least in the Sydney area, here is a list of the stations and the approximate frequencies which I logged on this converter. In the VLF region I was able to tune the US navigation station located at North West Cape, in Western Australia and on 22.3kHz. On the higher frequencies I logged the following, being identified in Morse code. BK 213kHz, ETL 220kHz, SDM 235kHz, WOL 244kHz, WPB 255kHz, CN 282kHz, SY 319kHz, RI 350kHz, KAT 357kHz, WLM 369kHz, VIS 500kHz.

In addition to this list, there are many other stations on various frequencies and locations. There is a station in Canberra on somewhere about 40kHz. Then there are various Loran stations on 100kHz and other frequencies and although they are located well outside the Australian scene, it just may be possible to receive one or more of them.

This is not all by any means, although once again many are located at great distances from Australia. There are stations in operation down as low as about 10kHz. There may be a lot of fun in trying to log some of them, even though the information which is transmitted is of little if any entertainment value.





These two views clearly show the layout inside the case. Battery leads are run through a hole drilled in the end of the box near the coax socket.

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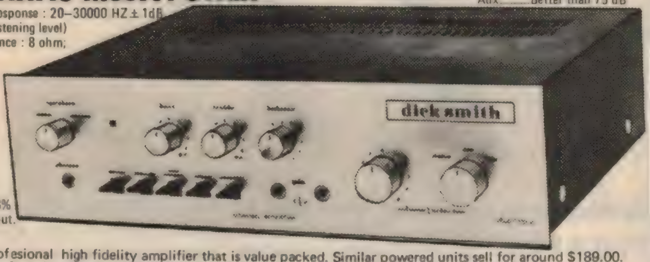

Harmonic Distortion : Less than 0.8% at rated output.

A profesional high fidelity amplifier that is value packed. Similar powered units sell for around $189.00. Inputs for microphone, turntable, tuner etc. Smart brushed satin finish, weighs in at 12 lbs and measures 36 x 9.5 x 25.5 cms. 240 volts AC. Cat. A 1262 .... $ 129.

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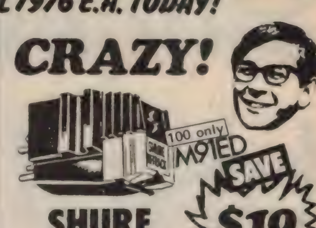

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NORMAL 1/2inch SPACE FIXING WILL FIT MOST TURNTABLES.
FOR THE TECHNICO'S – OUTPUT IS : 5.0mV per CH @ 1,000Hz @ 5cm/sec PV.

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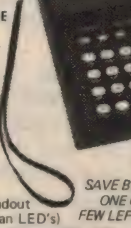

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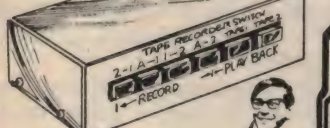

AUDIOPHILES & TAPE ENTHUSIASTS GRAB ONE OF THESE!!
YES, THIS LITTLE UNIT IS THE ANSWER TO YOUR PRAYERS.

DIG THIS CUTE ITEM !
Dub from one tape unit to another tape unit using this beaut tape switch. Yes - if your Amp does not have dub features then just add this switch unit and have a feature more expensive Amps boast of ! No need for messy patch cords here. Now you can simply switch between your audio gear.
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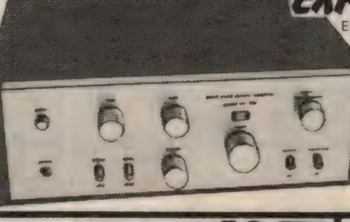
EXPO 1212 STEREO AMP

EXPO DX 1212 12 + 12 WRMS STEREO AMPLIFIER



Full control amplifier - smart design with switches for loudness - tape monitoring - stereo/mono and high filter. Will take your Goldring ES 70S through its magnetic phono input. Frequency response from 20hz to 25khz - S/N ratio better than 60dB on phono. Also accepts stereo Headphones 8-16 ohms.

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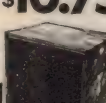

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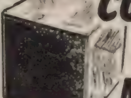

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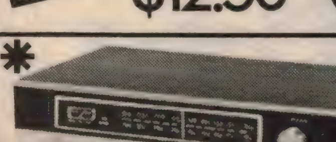
Ideal extention speaker. Handsome complete unit with 4" speaker. Buy now and SAVE well over $ 2.00
Cat.A2457 .... $4.50

INCREDIBLE EXPO CR50



NEAR COST! $79.

A Tuner - Amplifer offering fantastic features : Full 6 watts RMS per channel. Two speaker system switch plus all usual controls. And greatest of all - Full MPX Stereo FM Radio incorporated plus AM Radio. Feature this unit in your rumpus room audio system for this ridiculous price.
Cat. A1660 .... Near Cost Give Away Price .... $79.

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Provides a drift-free ultra sharp performance with strong automatic frequency control coupled with dual varicap electronic tuning, followed by a 4-pole ceramic filter IF section for extra selectivity. Greater adaptability results from the tuner & stereo decoder section being made available separately. Tuning Range 88 to 108 MHz. AFC switchable, with thermistor control to prevent drift. One 26 transistor IC. Distortion 0.3% at 1kHz for 75kHz deviation. 23-32 volt Power requirement.
Cat. F4315 .... $34.50

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PROJECT 80 STEREO DECODER

This unit gives a 30dB channel separation with an output of 150mV per channel. Gallium arsenide light emitting diode automatically lights up to show when a stereo transmission is tuned in. One 19 transistor IC. Power requirements 23-30 volts. Size 47x50x20mm.
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Simple function generator based on a single IC

What's cheap to construct, easy to build, has six spot frequencies, three waveshapes, an adjustable output level, and runs from a small 9V battery? It's the MINI-GEN, of course, so if you have a need for a small portable test oscillator, read on.

by DAVID EDWARDS

Mounted in a small plastic box, and powered from a tiny "216" type 9V battery, this little generator will supply sine waves, triangular waves and square waves with amplitudes in excess of 2V RMS at frequencies of 10Hz, 30Hz, 100Hz, 300Hz, 1000Hz and 3000Hz. We estimate that the total cost of all components will be about $15.00.

The MINI-GEN, as we have christened it, is based on a single low cost integrated circuit. This IC, the LM3900, contains four differential input operational amplifiers in a single 14 pin DIL package. Designated "Norton Amps", these new op-amps have current differencing inputs rather than conventional voltage differencing inputs, and operate from a single supply rail.

Essentially, the output voltage of the op-amp is determined by the difference between the currents applied to the inputs, rather than by the voltage difference as is usually the case. Both input terminals are clamped at $+1V_{BE}$ above ground, and input resistors are used to convert from input voltages to input currents.

Output biasing is obtained by providing a current path from the positive supply rail to the non-inverting input.

Referring now to the circuit diagram, we can see how the four op-amps have been combined to produce the required waveforms.

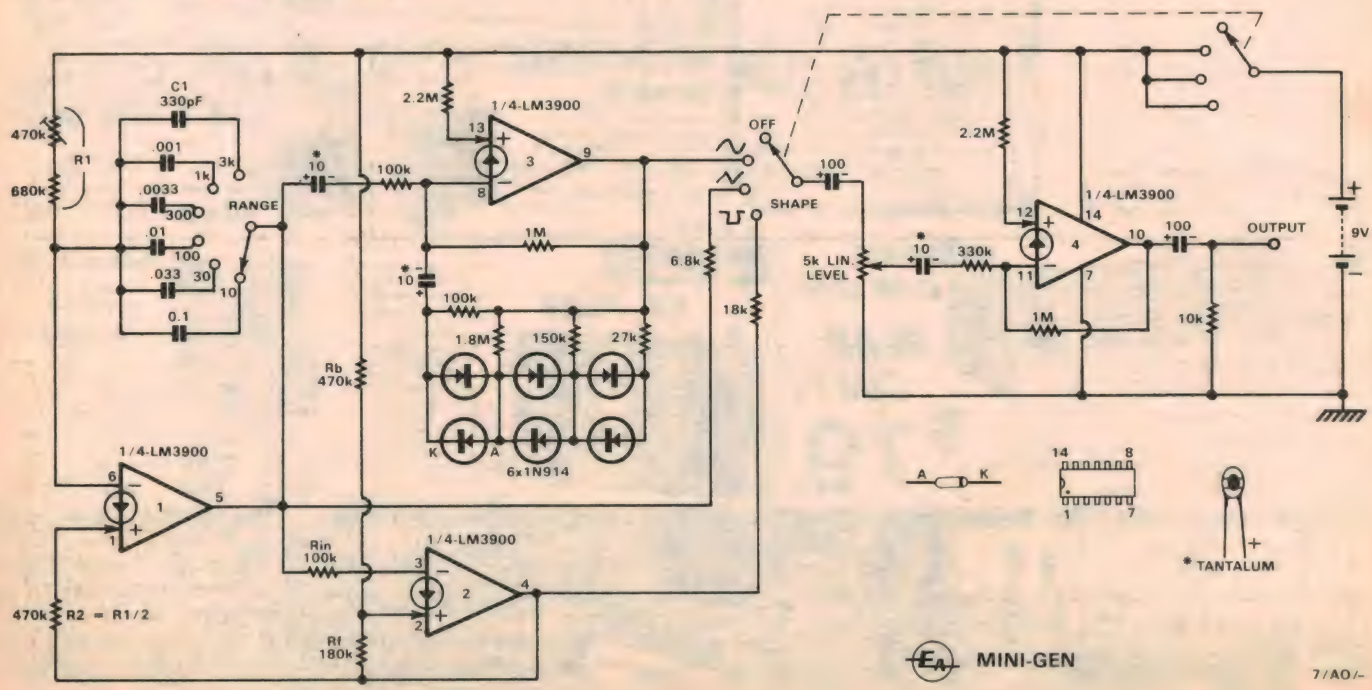
Amplifiers 1 and 2 function as a combined triangle and square wave generator. Initially, C1 is charged, and the output of amp 2 is low. C1 commences to discharge in a constant current mode, and the output of amp 1 decreases linearly with respect to time. No current flows through R2 = ½R1, and the rate at which C1 is discharged is determined by R1 alone.

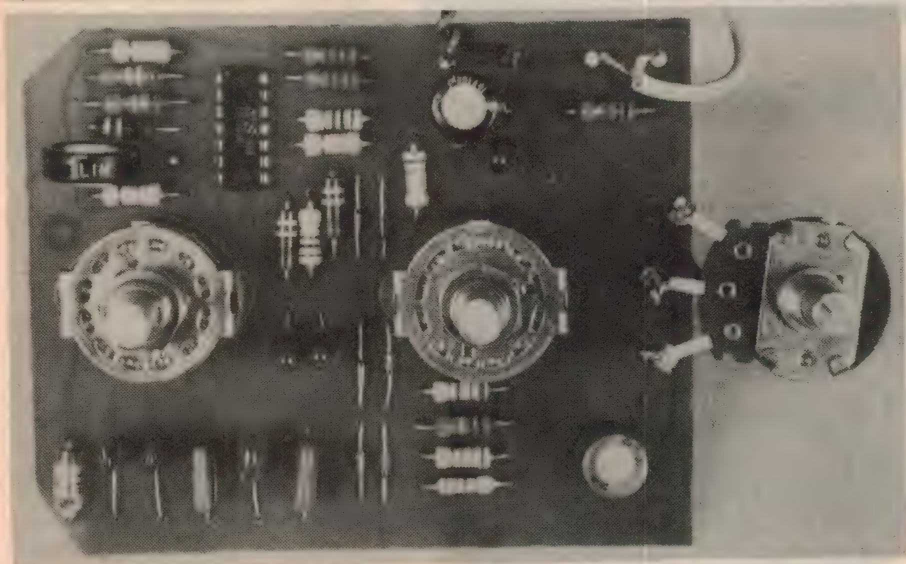
When the current supplied to the inverting input of amp 2 via Rin falls below that supplied to the non-inverting input via Rb, the output of amp 2 goes high. This supplies current to the non-inverting input of amp 1 via R2. Since R2 is exactly half of R1, this current is twice that through R1, and C1 commences to charge at the same rate at which it was discharging. This causes the output of amp 1 to ramp upwards.

The high output of amp 2 also supplies current to its own non-inverting input via Rf. This means that the output of amp 2 will not go low again until the voltage at the output of amp 1 is such that the current through Rin exceeds the sum of the currents through Rb and Rf. When this does happen, C1 commences to discharge again, and the output of amp 1 ramps down again.

Thus a triangle wave is produced at the output of amp 1, and a square wave at the output of amp 2. The latter has an amplitude only slightly less than the supply rails, while the amplitude of the former depends on Rin, Rf, and the supply rail. Rb determines the quiescent output voltage of amp 2.

Frequency of operation is determined by R1, R2 and C1, and is substantially independent of supply voltage variations. If R1 is made twice R2, the





Details of the front panel layout are shown in the photograph at top. Directly above is a view of the assembled PC board.

PARTS LIST

SEMICONDUCTORS
1 LM3900 quad op-amp.
6 1N914 silicon diodes.

CAPACITORS
2 100uF 16VW PCB mounting electrolytics.
3 10uF tantalum.
1 0.1uF plastic.
1 0.033uF plastic.
1 0.01uF plastic.
1 0.0033uF plastic.
1 1000 pF plastic.
1 330pF plastic.

RESISTORS (all ½W)
2 2.2M, 1 1.8M, 2 1M, 1 680k, 2 470k, 1 330k, 1 180k, 1 150k, 3 100k, 1 27k, 1 18k, 1 10k, 1 6.8k, 1 680k linear trimpot, 1 4.7 linear pot.

MISCELLANEOUS
1 2 pole 6 position rotary switch, SRM162 (S2302) or equivalent.
1 3 pole 4 position rotary switch, SRM143 (S2303) or equivalent.
1 plastic utility box, type UB1, 150 x 90 x 50mm or similar.
1 RCA socket and jack.
3 knobs.
1 printed circuit board, 99 x 82mm, coded 76ao3.
1 miniature 9V battery and clip to suit.

Scrap aluminium, solder, hook-up wire, machine screws and nuts, circuit board pins, tinned copper wire.

Note: resistor wattage ratings and capacitor voltage ratings are those used in our prototype. Components with higher ratings may generally be used provided they are physically compatible. Components with lower ratings may be used in some cases, providing ratings are not exceeded.

waveform from amp 1 is triangular rather than sawtooth, and the square wave from amp 2 has a mark/space ratio of unity.

The circuit diagram shows R1 composed of a fixed resistor in series with a variable one. If you do not have access to test equipment, simply make R1 and R2 from three 470k high tolerance resistors. If you do have access to test equipment, the values shown in the diagram can be used. The trimpot can then be adjusted so that the mark/space ratio of the square wave is unity. This will then minimise the second harmonic distortion present in the sinewave output.

A six position single pole switch is used to select different values of C1, to give a range of frequencies. The maximum useable frequency is about 3kHz; with frequencies higher than this slew rate limiting occurs inside the op-amps, and the output waveforms deteriorate markedly.

Low frequency operation is limited only by the input bias currents, and operation at frequencies of the order 0.1Hz is quite feasible. At these frequencies, large capacitors may have to be used, and leakage may become important.

With the values shown on the diagram, the nominal operating frequencies are 10Hz, 30Hz, 100Hz, 300Hz, 1000Hz and 3000Hz. With standard value components, actual operating frequencies should be quite close to these figures.

Amp 3 is connected as an AC coupled sinewave shaping amplifier. Diodes in the feedback network are used to convert from the triangular wave input to an approximate sinusoid, by selectively changing the slope. The output sinewave has a distortion of about five per cent, and is reduced in level with respect to the input.

The SHAPE switch, which also functions as a power switch, selects one of the three waveforms and feeds it to the LEVEL control. The resistors in series with the triangle and square wave inputs, have been chosen to equalise the three waveforms in terms of peak-to-peak level at the LEVEL control wiper.

The output from the LEVEL control is amplified by amp 4, which has an AC gain of about 3 and acts as an output buffer. The output is AC coupled via a 100uF electrolytic capacitor. This size capacitor is necessary to prevent noticeable degradation of the square wave at very low frequencies. The 10k resistor across the output provides a charging path for the capacitor on initial turn-on.

Construction of the MINI-GEN is very simple. We have designed a small printed circuit board, coded 76ao3, on which nearly all components mount. This board has been designed for use with the type of switches mentioned in the parts list. These are available from Dick Smith Electronics at a very reasonable price.

As you can see in the photographs, the

PHILIPS Test and Measuring Instruments

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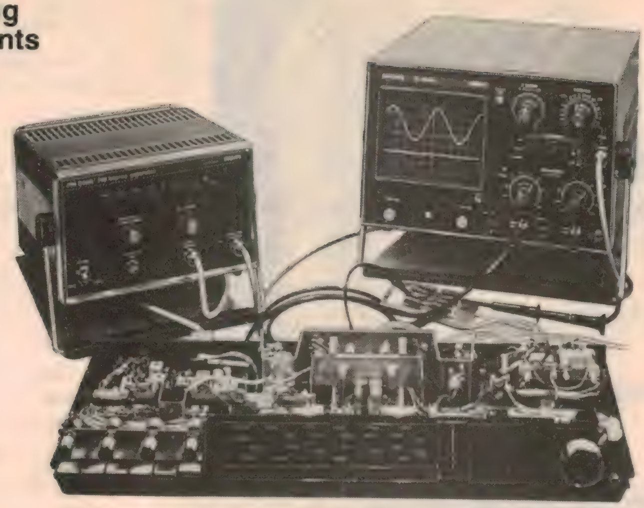

Aligning F.M. stereo receivers?

Save time with this stereo generator.

Most stereo faults are a result of component drift, an effect that can be fairly simply corrected by re-aligning the receiver.

A transmitted stereo signal is difficult to quantify and is not suitable for receiver alignment. The Philips FM6456 produces a standardised stereo multiplex signal from which the various signal components can be selected by push buttons. These signals are reproducible and easy to use for adjustments. The stereo signal is fully adjustable.

The test signals provided include a crystal controlled 19 kHz Pilot, internal one and five kHz Modulation, provision for external modulation, right channel only, left channel only, both channels in anti-phase (R = L). The generator produces, when switched, a 100 MHz signal which can be frequency modulated by the multiplex signal.

The test signals provided by the PM 6456 facilitates the tracing of such faults as phase error between the pilot signals and the regenerated carrier, demodulation phase error and probably the most common fault, crosstalk between channels.

External modulation of the RF output with a stereo record player or tape recorder allows a final audio check to be made and is a useful feature for demonstrating F.M. Stereo receivers to your customers. For further information phone our nearest office or send this coupon.

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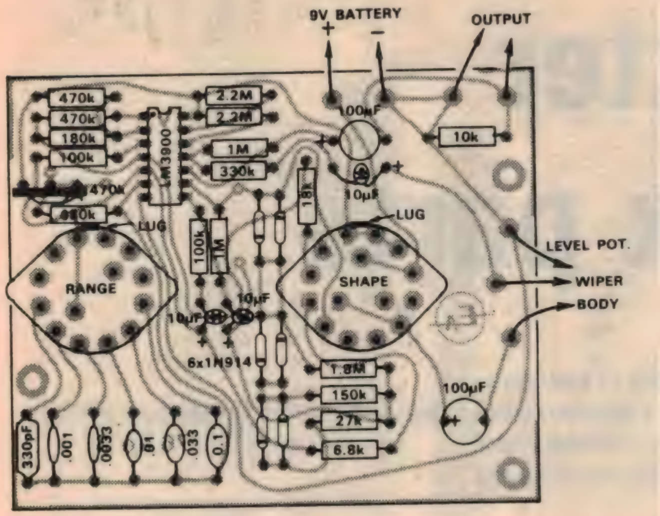
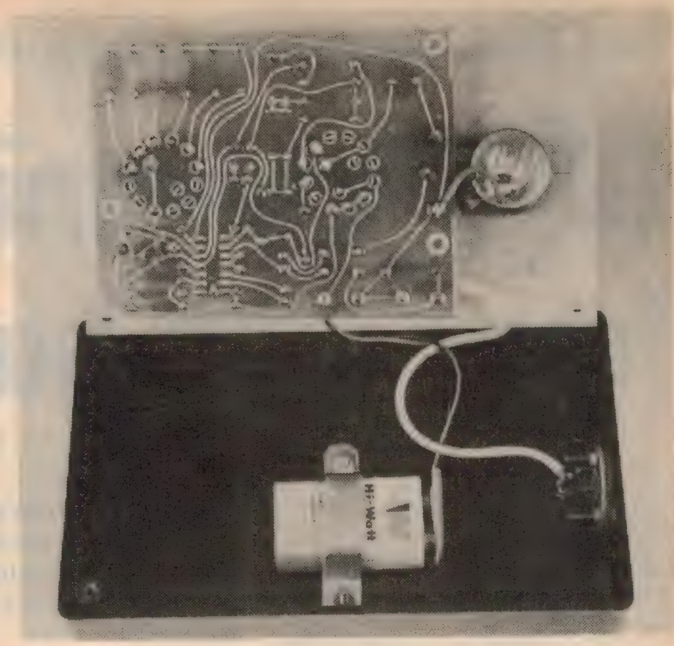
38.2529

Simple function generator



Layout of components on the PC board. Pay attention to polarity conscious components.



The PC board is mechanically supported by the two switches soldered directly to it. Note battery clamping details.

PCB is simply soldered directly to the switches. This provides ample mechanical support, and eliminates the need for spacers and the like. The LEVEL pot is also mounted directly on to the PCB, using short wires as standoffs.

If you are unable to obtain suitable switches, other types can be pressed into service by simply wiring them to the board, using short lengths of hook-up wire. In this case, it will be necessary to support the PCB, so we have provided space on the pattern for three mounting holes. Comparison of the PCB pattern with the circuit diagram will enable the appropriate connection points to be determined.

Construction is best started by drilling the PCB to take the switches. Use a drill which is only slightly larger in diameter than the lugs of the switches, and then, if necessary, bend the switch lugs to suit. Do not solder the switches in place at this stage.

Next, using the PCB overlay as a guide, fit and solder all the remaining components to the PCB. The IC may be carefully soldered directly to the board. Check carefully that all polarity conscious components are fitted correctly. The battery connector is soldered directly to the relevant terminals, using PCB stakes if desired. The leads to the output socket can be either twisted hookup wire or shielded cable.

Drill the required three holes in the front panel next. These should be located on the centre line, with the centre one in the exact centre of the panel, and the other two spaced 51mm away on either side. Stick-on lettering can now be applied directly to the panel, and protected by spraying with a clear lacquer.

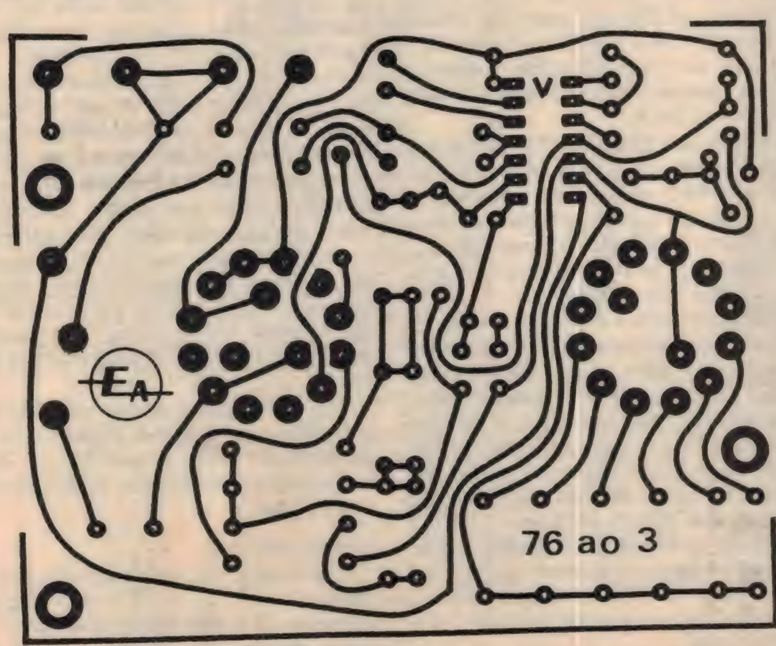
The switches can now be fitted to the PCB. The locating lug on the body of the switch should be placed on the side of the board near the IC. Only the lugs required need be soldered to the pattern. This will make later removal, if required, a lot easier.

Now loosely crimp three short lengths of tinned copper wire to the lugs of the LEVEL pot, and fit it to the front panel, using nuts on both sides. It must be fitted with the minimum amount of bush above the panel. If extra nuts are not available, the pot can be packed out with washers.

Then fit the switches and PCB assembly to the panel, and feed the copper wire through the correct holes. The switches must also be mounted with nuts on either side of the panel, to provide sufficient clearance for the components. After all the nuts have been tightened, solder the wires both to the pot lugs and to the PCB. This will locate the pot, and the front panel can now be removed if necessary.

The body of the LEVEL pot should be connected to the negative supply rail by a short length of hook-up wire. This will connect the front panel and knobs to the negative supply rail also, and provide a partial shielding effect for the circuit.

Complete the construction by clamping the battery to the bottom of the case, and fit the output connector to the end next to the level control. If you have fitted a trimpot as part of R1 monitor the output and adjust it for best waveform symmetry or minimum second harmonic component, as detailed earlier.



The PC pattern, reproduced actual size to facilitate tracing.

For the experienced amateur:

DSB transmitter from junk-box parts

There must be many radio amateurs who have a collection of old components lying idle in the junk box. This article should provide some incentive to turn those components into something useful. It describes a DSB transmitter that is simple to build and uses a minimum of costly components.

by JIM WALLICH (VK2BNQ)
36 Darnley St., Gordon, NSW 2072.

Many ideas have come about by chance. The subject of this article is just such a case.

I had intended to build a compact SSB transmitter suitable for both fixed station and mobile use and covering 160, 80 and 40 metres. However, early in the drafting stages I found that my expensive little mechanical filter was missing since moving house from Melbourne to Sydney. I was not prepared to indulge in the extravagance of buying a new one, but what was I to do with this burst of pent-up energy to build something?

It was then that I conceived the idea of making a similar transmitter, but using DSB and with a minimum of costly components. Perhaps some of those forgotten bits and pieces in the junk box could be persuaded to talk.

I first satisfied myself that the reception of DSB would present no problems to anyone with an SSB receiver. However I later found that unless I told anyone I was on DSB, they assumed I was on SSB.

DSB is less efficient than SSB. But for a true comparison of talk-power one should relate AM, DSB and SSB to each other. The two side band signals are superior in every respect, and the performance of this DSB transmitter gives no cause for dissatisfaction.

The design criteria were to be economy, simplicity, reliability and mobility. The result has been an outstanding success and I felt compelled to pass it on in this article to those whose pockets may not be too deep, to those wanting a low-priced compact rig, to the young amateur, and to the maniac like me who just likes to build.

CIRCUIT DESCRIPTION:

In most respects the circuit follows standard well proven lines, so individual stages will no doubt appear familiar. Two tubes are used in the audio stage, the second feeding directly into the balanced modulator at low impedance from the cathode. Consequently, there is more than sufficient gain.

The crystal oscillator, V4, uses a crystal on 2465kHz. Any crystal which is within plus or minus 200kHz could be used without affecting coil dimensions or capacitor values elsewhere in the circuit. Beyond this limit I am not prepared to comment. Certainly this and the VFO frequency selections should not be departed from too much, otherwise spurious frequency products will become a problem.

The balanced modulator is straightforward. Although I could not get a matched pair of germanium diodes, the carrier suppression is excellent. In point of fact I have used two quite different types of diodes, though their reverse DC resistance is similar. Output from the balanced modulator is DSB. This is amplified by V3 and fed into a double balanced mixer, V6, where it heterodynes with the output of the VFO.

It is important that the VFO be clearly understood, as it is the heart of the design. The VFO coil can be switched to three separate bands of frequencies which, when mixed additively or subtractively with the crystal frequency, will give output on the required band.

Construction must be rigid to ensure freedom from mechanical movement and frequency shift, particularly as the switches are part of the frequency sensitive circuits. For this reason, it is recommended that heavy gauge aluminium be used for both screening and the chassis.

The plate circuit of the VFO is tuned by L2 to ensure plenty of output. The 330 ohm resistor connected from one side of the 470pF coupling capacitor to ground provides sufficient damping to achieve a flat frequency response over the 1900kHz band.

The VFO is required to cover from 4265kHz to 6125kHz and this is done by arranging a tap so that we can select 4535-4685kHz on one switch position (for 40 metres), and 5965-6165kHz on another position (for 80 metres). The 160 metre band is covered by using the third position of the switch, to bring in additional capacitance such that the VFO covers 4265-4325kHz.

The output of V6 is to a band switch to feed three separate coils, one for each band. The primary winding of each of these coils is bifilar wound.

The driver stage is straightforward, as is the power amplifier. However, the 150pF coupling capacitor from SW1E to V7 should be located in the same compartment as V6, away from the V7 plate circuitry associated with SW1F. The lead to the grid of V7 should be screened right up to pin 2. It would even be worth extending the screening over the pin. Earth both ends of the shielding.

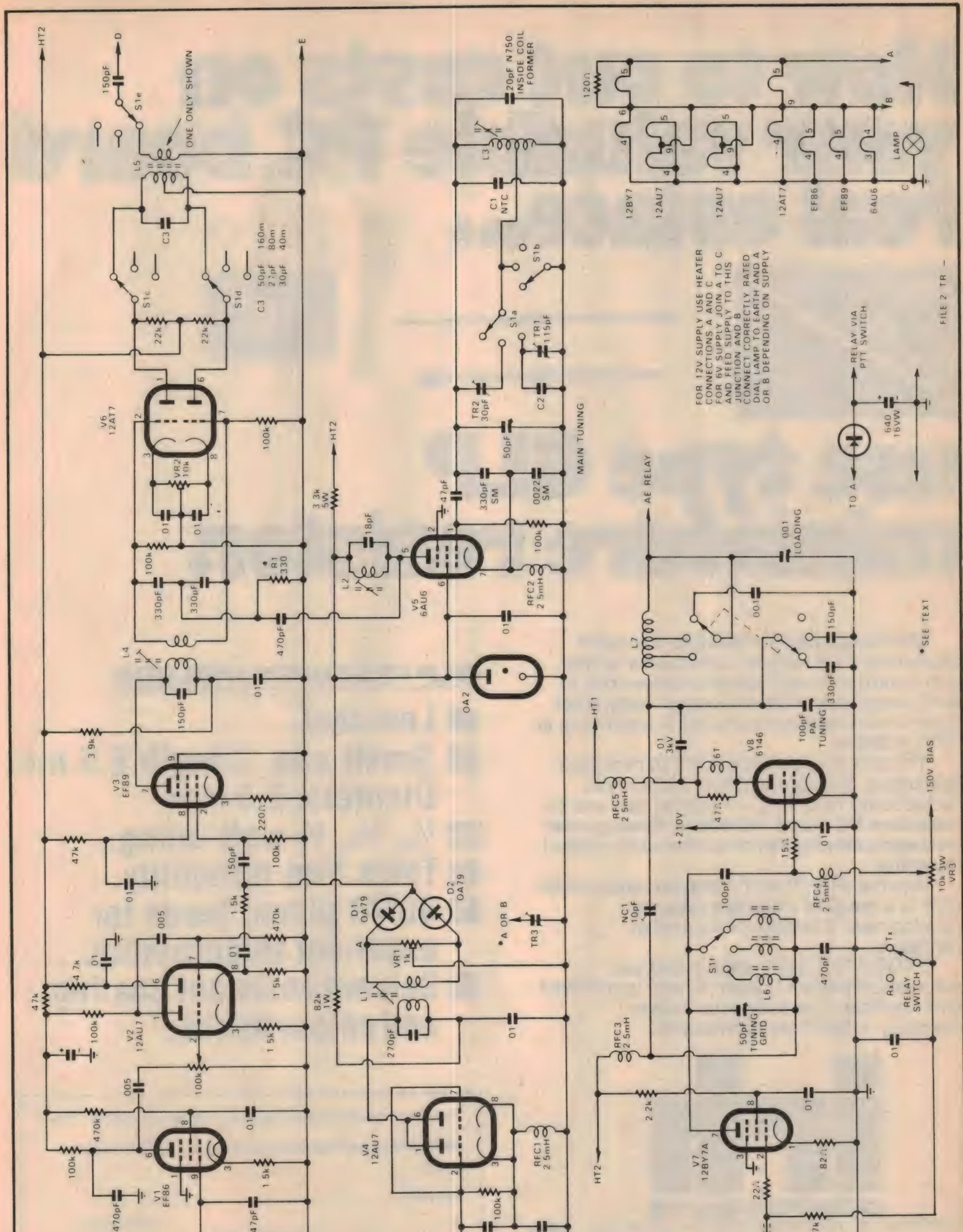
Power supply requirements have been met by a 350-0-350V mains transformer with a 150mA rating. Diode bridge rectification was used, giving an off-load voltage of 800V and an on-load voltage of 660V (HT1). The centre tap provides 340V off-load and 300V on-load (HT2).

The transmitter has been designed for either 6V or 12V heater supply, depending upon your mains transformer. The appropriate wiring details are shown in the circuit diagram. Relays may be 6V or 12V.

Bias is obtained in my case by using a small speaker output transformer connected back-to-front and using a 3V tap in the mains transformer. In this way I get −250V bias.

COMPONENTS:

The choice of components such as resistors and capacitors was dictated largely by size. No special thoughts were given otherwise. Resistors were ½W, capacitors can be disc ceramic or plastic


FOR 12V SUPPLY USE HEATER CONNECTIONS A AND C FOR 6V SUPPLY JOIN A TO C AND FEED SUPPLY TO THIS JUNCTION AND B CONNECT CORRECTLY RATED DIAL LAMP TO EARTH AND A OR B DEPENDING ON SUPPLY
MAIN TUNING
AE RELAY
RELAY VIA PTT SWITCH
RELAY SWITCH
150V BIAS
ONE ONLY SHOWN
20pF N750 INSIDE COIL FORMER
*SEE TEXT
FILE 2 TR

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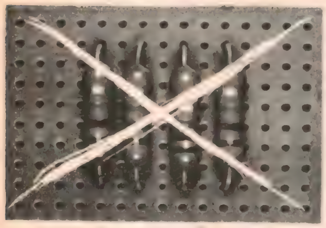

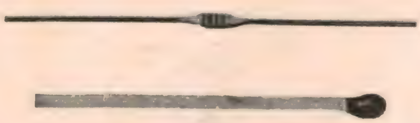

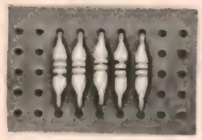

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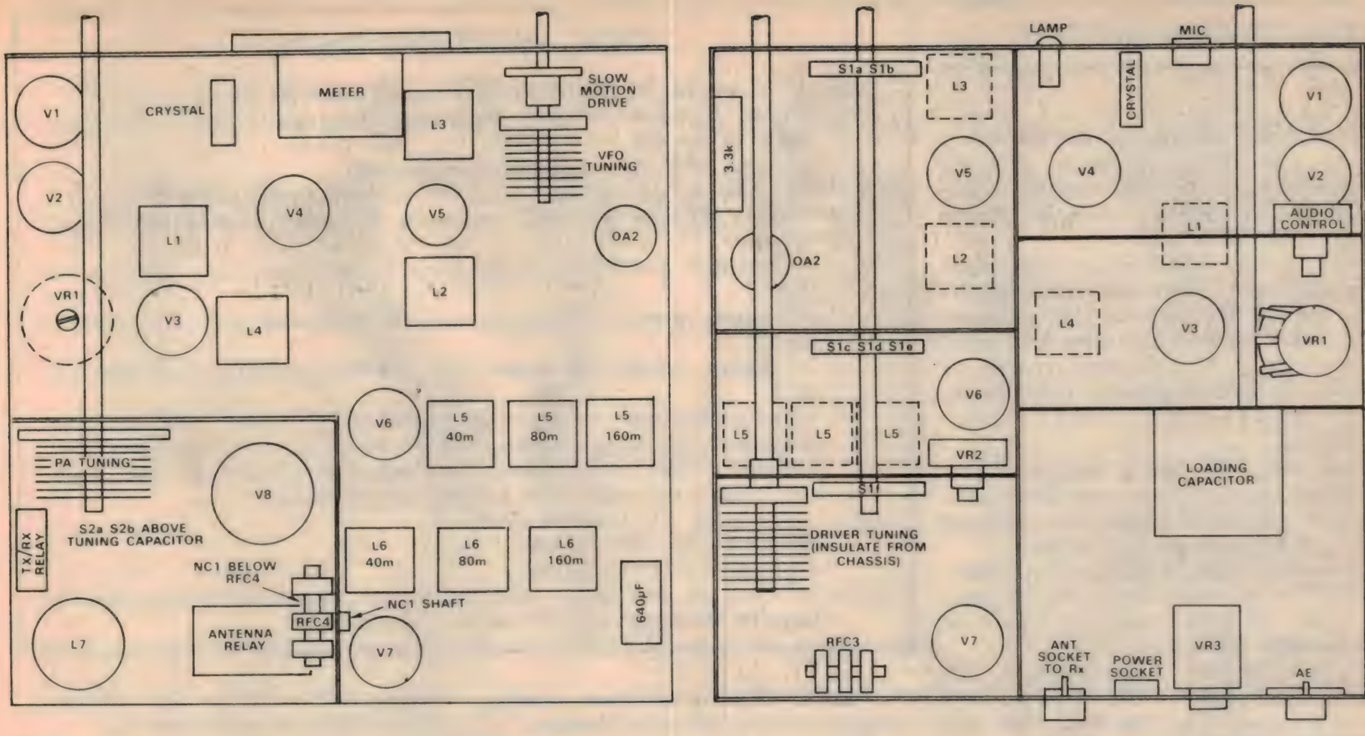


The above-chassis and below chassis component layouts are shown at left and right respectively.

encapsulated. Where this generalisation is departed from, a note is shown on the circuit diagram.

Coil formers are 0.3" Alladin, except in the case of L7. The 160 metre coil L5 is a 2¼" type whereas all the rest are 1¼" long. All RF chokes are standard receiver type, the only considerations being that where applicable they can carry the current involved (RFC4), and that the same type should not be used in both the plate circuit and the grid circuit of the same valve.

Switches are obviously a vital part of this design. Following is a run down of the various switches used:

- SW1A and SW1B is a double pole triple throw switch on the same wafer, and is contained in the VFO compartment;
- SW1C, SW1D and SW1E are contained in the balanced mixer section. If possible get a single wafer triple pole triple throw, otherwise you may have to use 2 wafers as I did.
- SW1F is contained in the driver compartment. This and all the previously listed switches are ganged.
- SW2A and SW2B are contained within the PA section, above the chassis. They should be single wafer double pole triple throw and should be capable of handling the strong RF circulating.

VARIABLE CAPACITORS:

The 50pF VFO tuning capacitor should obviously be a mechanically sound component, free of backlash. The 100pF PA tuning capacitor used was an old receiver type. The spacing therefore cannot be described as wide, but it is not as close in as for normal ganged tuning capacitors. The object is to find a compromise between maximum capacitance, minimum acceptable spacing and overall physical size.

The loading capacitor used was a twin ganged 350/350pF. Use a 500/500pF if you have one of small enough size or, better still, a 500/500/50pF.

LAYOUT AND CONSTRUCTION:

This article would be too lengthy if I were to go into detail on the subject of layout. I will therefore confine my remarks to the most important points.

The accompanying diagrams show the chassis layout. Not illustrated are SW2A and SW2B which are placed directly above the PA tuning capacitor. Likewise for NC1 which is secured to the PA compartment screen below RFC4, with the spindle passing through towards V7. The loading capacitor is placed underneath the chassis.

The underside of the chassis is divided into screened compartments by a grid or honeycomb which was precut, drilled (for switches, feedthroughs, etc.), and then assembled and fixed into the chassis.

Various controls are fixed onto this grid of screens. For example, the audio gain control passes through one screen such that the potentiometer is on the audio side while the spindle extends into the balanced modulator side. Similarly, VR2 is mounted under the chassis, and the bias control VR3 is mounted on the back skirt of the chassis with its spindle protruding to the rear.

I spent considerable time planning the layout of each stage to avoid a bird's nest. I recommend the trouble as time well spent.

VFO CONSTRUCTION AND ALIGNMENT:

The VFO must be sturdy to avoid frequency shift. The slightest movement of a wire or a screen will shift the frequency. All screens should thus be of heavy gauge aluminium and all interconnecting wires in this section free from movement.

The selection of components such as TR1 and its associated padder, TR2, and the negative coefficient capacitor C1 will have to be made by trial and error as these are dependent upon layout, the coil, and stray capacitance. The values given below are a basis from which to start, and are those finally used by myself.

In winding the coil note that the ferrite core enters from the earthy end. As adjustment to the coil must be made from the top of the chassis, the earthy end of the coil is at the top.

To align the VFO, power is switched on at HT2 only. Remember that you cannot remove any valves as this will upset the heater balance. Disconnect the 6146 screen supply. A calibrated receiver or other accurate frequency determining device covering the VFO range is required.

Set the VFO tuning capacitor to 5 degrees open (i.e., at nearly full capacitance). Alignment should now proceed on a step-by-step basis as follows:

(1) Switch to the 7MHz position. Solder a 47pF N750 capacitor into the C1 position and adjust the core to get the circuit to oscillate at 4535kHz.

(2) Switch to the 1.8MHz position. Solder a 220pF capacitor into the C2 position and adjust TR1 so that the circuit will oscillate at 4265kHz.

(3) Switch to the 3.5MHz position and adjust TR2 for oscillation on 5965kHz. It may prove necessary to add extra capacitance across TR2.

As the aim is to get all bands to commence at the same point on the dial, it will be appreciated that failure to achieve this by the above steps will entail further experimentation with the values of C1, C2 and the padder across TR2.

TRANSMITTER ADJUSTMENT:

Unlike the more general method of lining up, I prefer to start at the initial stages, i.e., the oscillators, and work forward. You will require a VTVM with an RF probe, and a meter capable of reading 1500V. Proceed with alignment as follows:

(1) Disconnect HT1 supply and 6146 screen supply.

(2) Turn audio gain to minimum.

(3) Switch to 7MHz.

(4) Check V4 for oscillation and adjust L1 for maximum RF output.

(5) Place RF probe at junction of D1 and D2. Adjust VR1 for minimum reading (should be about mid-way position).

(6) Turn audio gain up ⅓ to ½; place RF probe at pin 8 of V2. Check for increase on modulating with voice.

(7) Check V5 is oscillating.

(8) Place RF probe on V6 side of 470pF capacitor from V5. Adjust core of L2 for maximum.

(9) Short out L3. Turn VR1 fully one way to upset balance. Place RF probe on pin 7 of V3, adjust L4 for maximum, open short on L3.

(10) Place RF probe on secondary of 40 metre band coil, L5. Adjust core of L5 for maximum.(I recommend that at this stage coil cans be omitted so that coils can be dipped to the right frequency in circuit, and actual output frequencies readily checked.)

(11) Place RF probe on same point as for step 10. Adjust VR1 for minimum reading. TR3 is not at this time connected into circuit. Touch each side of VR1 with an insulated screwdriver and connect TR3 to the side which causes a further drop in the reading. Proceed to adjust TR3 and VR1 in conjunction to obtain minimum reading. (TR3 = Philips 30pF concentric + extra capacitance if required.)

(12) RF probe as for step 11. Adjust VR2 for minimum reading.

(13) Detune L2 and observe if reading for step 12 is reduced further. (A sensitive receiver with an S meter can be more revealing at this point than a VTVM.) Detuning L2 reduces the injection voltage into V6. An optimum point will be reached where the residual carrier cannot be reduced further without substantially reducing the output on modulation. At this point, measure the RF voltage at the V6 side of the 470pF coupling capacitor from V5. Select R1 to give this voltage when L2 is peaked at maximum.

(14) Place RF probe on pin 5 of V8. Adjust 40 metre coil of L6 for maximum on modulation (or unbalance VR1 again instead of modulating). The driver tuning capacitor should be half open. Readjust L4 and L5 for maximum reading.

(15) The HT1 supply and the 6146 screen supply should now be reconnected. Plug in a suitable 75 ohm dummy load. Switch on and adjust VR3 for standing current of 12½mA (VR1 at maximum carrier suppression).

(16) Retune L6 40 metre coil for maximum whilst modulating.

(17) By careful layout, neutralising has been found unnecessary. If required, the process of neutralising can be carried out in the normal manner.

(18) Tune PA tuning capacitor for dip, and increase loading capacitor to give a peak current of 112mA.

The set is now operational on 40 metres. An abridged version of the above process is used to tune the transmitter to 160 metres and 80 metres.

Finally, the accompanying tables give a complete list of coil details and a range of helpful voltage measurements. This should complete the information necessary to enable the experienced amateur to duplicate the design.

COIL WINDING DATA

Coils L1, L2, L3, L4, L5 and L6 are wound on 0.3-inch Alladin formers.

L1 — Primary 70 turns 36 SWG; secondary 25 turns 36 SWG wound over centre of primary.

L2 — 56 turns 36 SWG, enamelled, close wound.

L3 — 28 turns 29 B&S, tapped 11 turns from earthy end of winding.

L4 — Primary 70 turns 36 SWG; secondary 70 turns 36 SWG wound over primary.

L5 — 160 metres: primary 85 double turns 32 B&S; secondary 40 turns 32 B&S.
80 metres: primary 40 double turns 32 B&S; secondary 20 turns 32 B&S.
40 metres: primary 25 double turns 29 B&S; secondary 25 turns 29 B&S.
Primaries are bifilar wound, meaning that two wires are wound on at the same time next to each other. Thus 85 double turns = 170 turns total. The start of one wire is joined to the finish of the other to form the centre tap. Insulate secondary from primary with thin paper.

L6 — 160 metres: 140 turns 40 SWG.
80 metres: 95 turns 32 B&S.
40 metres: 50 turns 29 B&S.

L7 — 49 turns 20 SWG on a 1-inch coil former, tapped at 25 turns and 15 turns for 80 metres and 40 metres respectively.

TABLE OF VOLTAGE MEASUREMENTS

	With Push To Talk OFF	With Push To Talk ON	PTT on and with Modulation*
High HT	800V	660V	580V
Low HT	340V	300V	250V

*This indicates over-running of mains transformer, but is acceptable

RF probe on V4 anode: 1V
RF probe on junction D1/D2: negligible no modulation; with modulation 0.2V
RF probe on V5 anode: 160 metres 1.2V; 80 metres 0.8V; 40 metres 1.1V
RF probe on V3 anode: no modulation 0.1V; with modulation 1.7V
RF probe on L5 secondary: no modulation OV; with modulation 1.6V
RF probe at tap of L6: no modulation 0.2V, depending upon degree of carrier balance
Bias: on "Receive" −250V; on "Transmit" −55V

Forum

Conducted by Neville Williams

Time is running out for BC band DX

In terms of topicality, the letter reproduced below is about two months out of date, because it refers to material published in our 1975/6 Year Book. However, it raises a matter which is overdue for discussion—the changing attitude of the administering authorities, and of Government to the role of radio stations in the community.

Before getting on to this matter, however, it may be as well to reproduce, and comment upon, that part of the letter which refers to the Year Book, published in mid-December. The letter, by the way, comes from P.D. of Melbourne:

Dear Mr. Williams,

I am writing to you to comment on several articles which appear in the E.A. Yearbook.

Firstly, congratulations on the Book. It is so good to see that you have kept the high standard of your magazine and produced original articles, rather than a selection of reprints from the past year, as some overseas journals seem to do.

I am also glad that the Yearbook continues a list of Broadcasting Services. As a correction, the frequency of the ABC FM station in Melbourne will almost certainly be 105.7MHz, as tests on the previous frequency showed interference with a channel 5 repeater. There may also be frequency changes in other cities, as I believe that problems have arisen elsewhere.

As indicated in your listing, 3MBS-FM started transmitting on a frequency of 92.5MHz, but the power has since been increased considerably and is now 4kW ERP. When the power was increased, there was a considerable amount of TVI to both channel 0 and channel 7, made worse by the fact that the FM station is not co-sited with the TV stations and there is a large difference in signal strength in the residential area of Kew near the FM station. As a consequence 3MBS-FM has changed frequency to 93.7MHz with significant reduction in the TVI. In retrospect, 92.1MHz was not a good choice. The second harmonic falls within channel 7, and it is the second harmonic of channel 0. Even with the best possible suppression of spurious signals, non-linear tuners still regenerate interfering signals if the FM signal is strong enough. In addition, there were reports of interference by channel 0 to the FM station.

I notice that you reprint, apparently without credit, the article from the Telecom Australia house journal on the test transmissions for the ABC station here in Melbourne. A pity, I think, because I believe that full credit was not given to all the people involved within Telecom Australia. Also, from a partisan viewpoint, I didn't really like the implication in the heading that said "... music of quite unaccustomed depth, purity and strength" as 3MBS-FM since the increase in power in September to 4kW could fairly be said to provide a strong, pure and deep signal! And despite the remark later in the article 3MBS (not 2MBS, you copied their mistake) has a range considerably greater than 15 miles. It is received well in Geelong. Also, in addition to the test periods indicated which actually seem to be on the weekend as well as weekdays, the ABC station has music tests each afternoon.

The article is, I'm afraid, a good example of what happens when a journalist with no apparent technical background attempts to cover a technical subject, and I'm a little surprised you printed it unchanged.

In central Melbourne and the Camden-Campbelltown areas the BCB has awarded non-commercial licences for stations which are commercial within the terms of the Broadcasting and Television Act but which will not have regular commercials. I believe 3CR, run by the Community Radio Federation, will start broadcasting early in the new year on 840kHz.

I'm intrigued by your reference to "open hostility flaring in Melbourne" because of deep seated differences? Do you refer to the differences over the suitability of the ABC as a body to take the reins of an access station like 3ZZ, or perhaps the reported suggestions that 3ZZ might be replaced by a station with a 2JJ type format?

The points you raise about commercial viability are of course valid, but I think that there are strong counter arguments. In North America, in what I believe would be called "markets" of equal size to our major cities, there are many more radio stations than we have, suggesting that at least there is a capacity for some increase here.

Special interest stations, be they for an ethnic audience, serious music lovers or lovers of jazz, would not necessarily attract listeners from existing stations but might provide a service for people who do not listen to radio now as their favourite form of listening is not available. Special interest stations could be funded by commercials, by business sponsorship or by listener subscription, and need not be a drain on government funds.

As you point out, for a long time the question of broadcasting was put in the "too hard" category. The Minister for the Media, Dr Cass, received a report of an investigation into public broadcasting he commissioned shortly before the recent upheavals. I hope that this will be given due attention.

As a final comment on your article, I think that the pattern of broadcasting on 3ZZ Access Radio since it started in Melbourne do not support your remarks. As I have heard it, access radio has been at times unprofessional, at times boring but also at times illuminating. It certainly in no way has become a facility providing a rostrum for "irrational or obscene" individuals.

Thanks for your attention to my comments, and an interesting magazine.

P.D. (Melbourne)

First off, we are glad that P.D. (and others) appreciated our efforts with the Year Book and, in particular, the emphasis given to radio and television broadcasting. If there are errors and omissions in the station list, we can only apologise and will hopefully seek to eliminate them when the list is up-dated next time around.

It sounds like a very simple assignment to complile a list of stations, locations and frequencies and perhaps it would be if it were not just one of a multitude of tasks to which our staff have to address themselves. The problem is that official lists are usually many months out of date and it isn't easy to keep track of changes particularly, as at the end of last year, when they were being promoted by other than the usual authority!

The interference problems between FM and TV, mentioned by our correspondent, generate yet another hazard to published lists and the saga is likely to continue as new FM stations come progressively into service. The Broadcasting Control Board warned that problems would arise, but they now have

to find ways around them. Unfortunately, potential solutions have to be tested by trial and error because so much depends on how interference-prone the receivers are that are being used by Mr Everyman on Everystreet!

And the story on Melbourne's unexpected FM broadcaster? Yes, it did come from the Telecom house journal, from which we also obtained the pictures. Omission of the credit line was perhaps a minor oversight, but the article did carry its own credit to the organisation. We reprinted the item because of its potential interest and the fact that it fitted neatly into the context of the Year Book. Perhaps a few phrases were somewhat "journalistic" and perhaps the credit was not spread as widely as our correspondent thinks appropriate but we judged it to be interesting, nevertheless.

And that brings us to the second part of the letter which calls for more lengthy comment:

I hope you will not mind if I mention a few points suggested by your accompanying article "Radio will change in '76". In addition to the factors mentioned in your article, I think that there was one other very important influence in broadcasting in the past year. This is the opening of the MF band to many more stations.

As you will recall, the Broadcasting Control Board in a surprise announcement towards the end of the independent inquiry into FM said that it would be possible to double the number of AM stations in Australia: interesting as, for many years, it had been said that there was little room, especially in southeastern Australia, for more stations.

I have not seen any journal articles or papers outlining the basis for the new policy, but from various public talks it would seem that this is made possible by advances in technology and a changed policy.

The new policy talks in terms of a defined service area. The station (national, commercial and especially community) is given a defined area to serve and the signal is tailored to serve this area alone, generally by the use of multi-array directional antennae. Thus the existing clear channels, until recently enjoyed by the majority of capital city stations, will give way to re-use of the same frequency several times, with directional arrays protecting the stations sharing a common frequency within their defined service areas.

This new policy is closer to the U.S. FCC policy for AM, which classifies frequencies into usage categories, ranging from "clear" channels serving large areas by sky-wave to local channels with over a hundred stations sharing a single frequency, with low power and very limited service areas.

I believe that the licensing of new commercial stations in and around Sydney and Melbourne and the new experimental stations you mention are part of the opening of the MF band. In addition to the ethnic stations you mention, and 2JJ, there are several other new stations that perhaps, political events willing, indicate possible changes in broadcasting. The university station 5UV in Adelaide has come in out of the cold, and though not shown on your list is now on the main AM band. It is broadcasting access, music and student programming and perhaps will be typical of the University and college stations recently given experimental licences (such as 4ZZZ-FM in Brisbane).

While all this is being turned over again in March, what appeared in the Year Book was actually written some time in October last (in between other jobs) and when a change in Government was being viewed merely as a possible complication. The article reflected the uncertainty, the apprehension and the undercurrents that characterised the broadcasting scene at the time. Details aside, the broad comment still stands, as also does the main thrust of the article and the end of the editorial in the front of the book: the need to "sort out what has happened and to evolve workable—if compromise—plans which will give a sense of direction to everyone involved".

(As we go to press, a new factor is entering the scene—an economy drive by the Government which is likely to slow up the process of change in any direction!)

The announcement by the Broadcasting Control Board suggesting the availability of more channels in the medium-wave broadcast band was interpreted by many as a clumsy about-face occasioned (1) by political pressure and/or (2) by technical pressure from the then-current FM inquiry.

Pressures there were, and it may have seemed like an about-face, but it did not herald the discovery of any new technical capacity for more stations. It was essentially a formal acknowledgement of a gradually changing attitude to band usage.

The early objective of medium-wave planning in Australia was to give as many stations as possible a unique frequency, so that their audience could be as wide as possible. Listeners took pride in the number of broadcast stations they could tune in successfully and station engineers derived their own special pleasure from long-distance reception reports. There had to be something rather special about a transmitter which could be picked up thousands of miles away!

Gradually, however, provincial listeners began to tire of their battle with day-time static and night-time fading and to agitate for their own regional and local stations—even if they had to share frequencies with stations in other states. So the process began: an audience shift away from distant big-city transmitters to local stations.

Paralleling this were two other impor-

FORUM

tant factors. The management of commercial stations began to realise that, from the viewpoint of an advertiser, the audience that really mattered was the one within commuting distance of the station—not scattered individuals and DX-ers out in the sticks! They had their own local station and their own local suppliers.

And, on the technical front, engineers had to concede that an aerial system which produced strong sky-waves and DX reports, did so by diverting that energy from the local ground wave. In this respect it was a liability.

As a result of all this, over many years, we have seen a gradual increase in frequency sharing, a gradual increase in the number of broadcast stations, and increasing use of aerial systems emphasising local coverage.

What the Control Board did, a few months ago, was simply to spell out what would be possible if this already established trend was to be carried to some kind of a conclusion. By confining each station's "rights" to a more rigidly defined area, many more transmitters could be accommodated in the same spectrum space.

However the Board's statement may have been misinterpreted by some at an emotional level, the broadcasting industry was under no illusions: one way or another, the "cake" was likely to be cut into smaller pieces!

Two propositions emerged from the debate, both with the potential to increase band occupancy: (1) more extensive sharing of existing channels and (2) sharing, plus a reallocation of frequencies on the basis of 9kHz separation.

That was all before the change in Government. How the present administration will react is anybody's guess but my tip is that it will (1) confirm the status of the Broadcasting Control Board and (2) have the Board inquire into the need for more local stations and the implications of that recommendation on band useage.

We would expect that the desirability or otherwise of more medium-wave stations will be decided primarily on social, commercial and economic grounds, with band occupancy a largely consequential result. We doubt that much thought will be given to the DX enthusiast who likes to log and listen to stations outside his own area.

We do wonder, however, whether the position could also become hopeless for the genuinely isolated listener and for tourists with car radios who tend to rely on a few, powerful, interference-free signals. After all, one doesn't want to spend the whole of one's life listening to cassettes!

THE NOISE PROBLEM

A rather grim corollary to all this is typified in the letter from a reader in Earlwood, NSW: the problem of interference from TV receivers. He mentions switched-mode colour sets in particular but the problem is much older than that, going back to the line deflection circuits of quite ordinary monochrome receivers. Maybe TV sets don't radiate far but, when there's one in every house in every street, they don't have to, to make their presence felt!

Add to TV receivers the ever-increasing use of thyristor type speed controls and light dimmers, plus an array of other electrical and electronic gadgetry, and we have a seemingly irresistible, rising tide of man-made RF interference.

Administrations can legislate against flagrant abuse of our electromagnetic environment but the tide still continues to rise. More transmitters, more powerful transmitters, improved technology will certainly maintain our local communications but we can only look back wistfully to the days when the main hazard to radio reception was the gently undulating ionosphere and the occasional thunderstorm.

Maybe those days have gone forever, along with many other aspects of a less technological age.

INTERFERENCE FROM TV SETS

Dear Sir,

I would like to raise the question of side effects associated with the switched mode type of power supply coming into increasing use in large screen colour television receivers.

The problem with this type of supply is the interference generated by the switching action. Although the manufacturers take considerable trouble to screen the supply and use of a considerable number of suppression components, my own experience suggests that the interference problem is still significant.

In the city of Wollongong it is difficult to use a broadcast band receiver, tuned to a Sydney station (50 odd miles away) when the household TV receiver is in use. Even in my own home in a Sydney suburb, I notice objectionable interference on the weaker stations from my own switched-mode TV receiver. I feel that the situation is moving rapidly towards what you mentioned in the August "Forum", with A's TV receiver affecting the radios of B and C, as well as his own.

L.H. (Earlwood, NSW)

The Serviceman

Batteries — and international standards

One of every serviceman's regular jobs is replacing batteries in a wide range of battery operated appliances—from pocket radios to movie cameras. While this should be a simple task, batteries and battery holders are not without their problems, as a recent incident emphasised.

While it may seem surprising that so many people cannot perform this simple job themselves, the fact remains that womenfolk, elderly people, and even some "with it" types become confused when faced with the task of fitting several cells in a typical battery holder.

Another point which becomes obvious to anyone refitting batteries regularly is that many holders designed to hold groups of cells leave much to be desired. A common problem is that they are moulded from plastic which tends to flow under stress, particularly the stress due to spring type negative contacts intended to ensure reliable contact at both ends. This can so distort the case that the spring pressure is substantially reduced.

Another problem concerns the eyelet style contacts usually used for the positive terminal. Again it seems to be a plastic problem, whereby these eyelets, while tight enough when new, gradually work loose. Since the electrical connection is normally via a lug secured under the eyelet noisy and intermittent behaviour results.

All of which is by way of being general background. What started me on the subject was a most unusual fault in the battery system of a 27MHz hand-held transceiver. It is powered by eight "AA" size cells to provide a nominal 12 volts. The cells are held in a fairly standard plastic holder, in two layers of four, with spring contacts at the negative end and eyelets at the positive end.

I thought I had encountered most battery faults, but this owner's complaint rather rocked me. According to him the batteries were overheating. In greater detail he explained that he had fitted a new set of batteries, only to find that the unit performed poorly while its own built-in battery meter indicated that the voltage was dropping fast. When he removed the cover in an effort to determine why, he realised that some of the cells were quite hot. Without stopping to enquire further he quickly removed the cells, packed the whole lot up, and sought my help at the first opportunity.

The first thing I did was to check each cell by measuring its voltage across a suitable load. The owner had in fact given me both sets of cells; the ones he was discarding and the new ones intended as replacement. It appeared that the unit was a new one, the discarded cells being of Asian make, as supplied with it, while the replacement ones were local "Eveready" types. At least this prevented them from getting mixed up.

The discarded cells read about 1V or a bit less, which was more or less what I expected. Most of the new cells read around 1.4V—again what one might expect—but two of them read only a little over 1 volt, which was rather puzzling.

Next I connected a milliammeter between one terminal on the battery box and the mating terminal on the lead connector, switched the unit on, and then pushed each cell into place. When the last one went in the needle moved up scale to what I felt was a reasonable "no-signal" reading. But then I realised that the current was falling and I glanced quickly at the set's own meter. It was falling too and, at the same time I realised that the cells were getting hot.

More precisely, it was two cells only, as I realised when I quickly pulled each cell from the holder. This seemed to suggest that the fault was in the holder rather than the set itself. I examined the holder carefully but could find nothing which would cause such behaviour.

So I took a single cell and fitted it into each position in the holder in turn. It wasn't long before I found a position in which the single cell started to overheat; a situation which left no doubt that the holder was at fault.

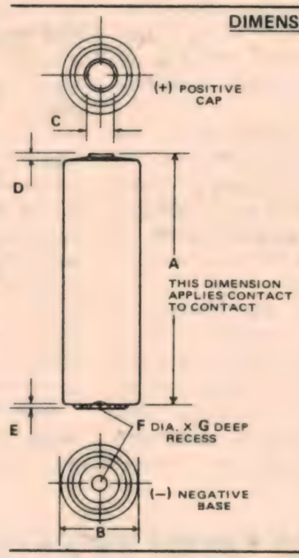
But what kind of a fault? I could see nothing obvious and the situation was reaching the silly stage. Then I took another look at the cells. The "Eveready" cells had a metal disc on top with a central hole through which protruded the positive terminal. I assumed (correctly) that this disc was part of the leakage protection assembly. The Asian cells had no such fitting, only a red insulating disc.

Australian batteries and cells are made to standards set down by the Standards Association of Australia (SAA), the specific standard being C387-1967. Shown here is portion of an engineering drawing from Union Carbide Aust. Ltd, makers of "Eveready" batteries, of the popular 1.5V "AA" size cell. These dimensions conform in all respects to the SAA specifications. These are based, in turn, on the International Electrotechnical Commission (IEC) standards.

"EVEREADY" No. 915

type — Leclanche
S.A.A. Designation — R6

DIMENSIONS



MILLIMETRES

BODY	
A	$50.01\,^{+0}_{-1.59}$
B	$14.30\,^{+0}_{-0.79}$
TERMINALS	
C	$4.72\,^{+0}_{-0.79}$
D	1.00 MIN.
E	0.13 MIN.
F	1.98
G	0.79

On an impulse I reached for the multimeter and measured the voltage between the positive terminal and the metal disc. It showed 1.5V, clearly indicating that the metal disc was in contact with the outer zinc container of the cell.

That much established I took another look at the positive terminal on the battery holder, then slipped the cell into place again. As I suspected, that was where the trouble was. The opening in the eyelet was large enough to allow both the positive terminal and the metal disc to touch it.

I'm afraid this discovery came as rather a shock, as well as posing a lot of ques-

tions. Did it mean that this equipment could be used only with imported cells, not featuring leak resistant techniques? Did it mean that standards—international standards which are supposed to prevent this kind of thing—had fallen down somewhere? And if so, which was wrong, the battery holder or the local battery manufacturer?

There was also the more immediate question of how to solve my customer's problem—other than by telling him to use only a certain type of battery. I took another look at the eyelets and decided that the margin by which the combination failed was quite fine, which was probably why only two cell positions were faulty.

The eyelets had a marked curvature and it seemed to me that if I could flatten them slightly it would have a twofold effect; the hole into which the positive terminal fitted would be reduced slightly, thus preventing the terminal from penetrating so far, and the flattened eyelet would be further away from the metal disc as well.

In fact, the idea worked, and I was able to send the customer on his way with the reassurance that he should be able to use any cells that he was able to buy anywhere.

But what of my original questions? How had this happened and what had gone wrong? I was so intrigued that I rang someone I knew at Union Carbide, who make the "Eveready" cells, told them what I had found, and asked them could they help.

The result was a very interesting discussion. They were well aware of the problem I had encountered and had already taken steps to prevent it. In fact, in all Australian made cells the metal disc is coated with an insulating material on the underside to prevent it making electrical contact with the zinc case. Under these conditions, of course, no problem could exist.

My friend went on to suggest that the cells I had were probably made in New Zealand. (Sure enough, a quick check on the label confirmed this.) Apparently the local factory had run into production problems, due to industrial disputes, and in order to keep faith with customers, the company had imported a quantity of cells from the New Zealand company. And, for some reason, this factory had not yet adopted the practice of insulating the discs. As soon as this was realised the New Zealand company was advised that all future supplies should conform to this requirement. In the meantime, the first batch was released on the basis that they would still be satisfactory in all but extremely rare cases.

On the broader questions, my friend confirmed that there were international standards, known as the IEC Standards, designed to ensure compatibility between cells and equipment anywhere in the world. These standards were the basis of the SAA (Standards Association of Australia) standards, and that all Australian cells were made to these standards.

Unfortunately, some Asian manufacturers have tended to ignore these standards, at least in regard to some of the finer points. This applies to both the battery manufacturers and, presumably as a result, a lot of the appliance manufacturers. Thus it is not unusual to find appliances which will not accept the local cells.

(I can confirm this. A colleague has an Asian made multimeter in which the battery holder is just too small to take the local cells, whereas Asian cells are a neat fit.)

According to the Union Carbide spokesman, this has caused a lot of embarrassment, and not only to the local battery manufacturers. Battery companies in Europe and America, who also adhere to the international standards, are just as upset at the situation. Like the Australian manufacturers, they are frequently accused of making incorrect size cells, whereas it is the appliance which is non-standard.

I gather that this situation has developed into something of a battle of wills. The Asian manufacturers have the advantage that they make a very large proportion of appliances now in use. On the other hand, European and American appliance manufacturers are not slow to exploit any suggestion that Asian appliances are non-standard and might create a problem for the buyer.

My friend went on to say that it now appears that the Asian manufacturers are beginning to realise that this situation, while perhaps to their advantage in the short term, could work against them in the long term. Hopefully, this will mean greater design care on their part in the future.

To change the subject, here is a story from a friend who is also in the electronics industry—in fact he has been part of it for longer than I can remember.

He bought a colour set, one of the top locally made brands. While well versed in matters electronic, he did not feel competent to take on this new fangled device and bought a service contract to cover it.

This particular set uses a dial lamp to illuminate the channel selector and, after a few months, this lamp failed. My friend probably could have replaced it, but hesitated to plough through a mass of cables he didn't understand in order to get to it. So he called the makers and had them send a serviceman out.

After the lamp had been replaced the serviceman asked, "Do you have a service contract?" When my friend replied that he did the serviceman commented, "Just as well. Otherwise I would have had to charge you $25."

"You're kidding!" said my friend.

"No I'm not," was the reply. "That's the charge. What's more, these lamps are crook. I've changed hundreds of 'em. They come from overseas and the set manufacturers have complained that they don't last, but the makers claim they are the only ones who have had trouble. And while they're squabbling about it, I'm replacing globes left, right and centre."

And finally, a brief summary of two more Rank Arena service bulletins. Their previous bulletins were summarised in the January 1976 issue.

RANK ARENA TECHNICAL SERVICE BULLETINS

ISSUE No. 5

Chroma Board PWC 411
- Factory changes on run No. 415-5. (Not required on receivers in the field.) PAL IDENT alignment instructions for runs 415-1-2-3. PAL IDENT alignment instructions for run 415-5.

Models C2601/2
- Errata for service manuals and circuit diagrams. Damped wave effect produced by vertical/horizontal line junction of cross-hatch pattern.

ISSUE No. 6

Model C1454
- Excessive green due to 4.43MHz radiation. (Sets with green sticker on carton or underside of receiver do not require modification.)

Model C2601
- Modification to minimise failure of IC 753. Factory modification only.

All Models
- DC power supply modification. Improved horizontal centring.

Models C2204, C2603, C2604, C2605
- Counter measure for horizontal ringing.

All Models
- Elimination of low channel regeneration.

Model 2603
- Improvement to channel 0 tuning range.

Model C1454
- Correction to resistor reference numbers. Corrections to service manual parts list. Change of deflection output board.

Models 2603 & 2604
- Increased fuse rating.

What's new in Solid State

More on opto-coupler uses

Following on from the introductory discussion given last month on opto-couplers, here is some further information on these handy devices. Extracted from applications material given in a recent issue of Philips' "Elcoma Brief", it gives a good idea of how to use the devices in typical circuit coupling situations. We reproduce the material by kind permission of Philips Industries.

One of the more important applications of photocouplers is in coupling digital sub-systems, because the high insulation resistance and low coupling capacitance given eliminates problems caused by earth loops and noise spikes.

TTL-to-photocoupler interface

The photocoupler can be driven from 7400 series TTL using one of the circuits shown in Fig. 1. Ideally, the operating speed of the photocoupler should be as high as that of the logic. Unfortunately, however, photocouplers operate at an appreciably lower speed, mainly because of the desaturation time of the phototransistor receiver. The phototransistor circuit should therefore be designed to have a low impedance, giving the highest possible switching speed and the most favourable noise margin.

The current transfer ratio is relatively low and fixed. The IR emitter diode current must be as high as possible to ensure saturation of the phototransistor in spite of the low impedance output circuit. However, as the diode current can be up to 30mA, the main restriction is set by the maximum permissible output current of the driving TTL gate. For active level LOW and active level HIGH, this is:

Active LOW
16mA with noise margin.
40mA without noise margin.

Active HIGH
8mA without noise margin.

The values of R (nearest preferred value) given in Figs. 1a and 1b are for gate currents of 16mA and 8mA respectively.

Receiver-to-TTL interface

The simplest circuit is shown in Fig. 2. The required value of R1 depends on the current in the IR diode, the current transfer ratio of the photocoupler, and the input requirements of the TTL gate. The value given (3.3k) allows the maximum speed for a photocoupler with If = 16mA and Ic/If = 20%. The data rate is typically 100kbits/s.

Relay replacement

Fig. 3 shows how a photocoupler can be used as a direct replacement for a relay. The advantages of such a substitution are: faster operation, no contact bounce, longer life, and high insulation resistance. The main disadvantages are the limited output current and on-resistance.

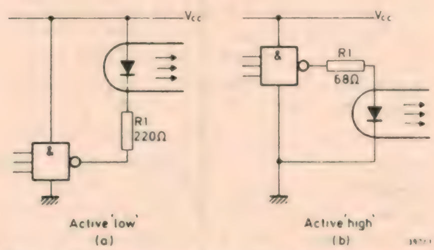


Fig. 1: TTL-to-opto-coupler interface circuits, (a) active low (b) active high.

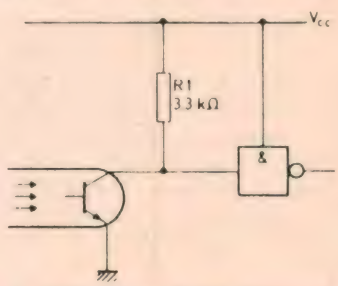


Fig. 2: Interfacing from opto-coupler receiver to TTL input.

Relay driver

Fig. 4 shows how a photocoupler can be used to protect low-power switching logic from transients occurring in an inductive load carrying high current. Using a photocoupler with a current transfer ratio of 20% and If $\simeq$12mA, a load current Il of 1.5A can be switched with $V_{CE(sat)} < 2.5V$.

Switching speed at full load (1.5A) is:

$$t_{on} = 10\mu s,$$

$$t_{off} 2.5ms.$$

Analog transmission

There is a wide range of industrial and consumer applications where photocouplers can be used to transmit analog signals between equipments at unequal earth potentials, or where it is necessary for several analog signals to be added in series to supply a common amplifier input.

Fig. 5 shows a practical analog isolator circuit. the circuit has 3dB roll-off points at 6Hz and 80kHz. Total harmonic distortion at 8V pk-to-pk output is less than 1.5% between 100Hz and 20kHz.

This circuit can be used in applications where the photocoupler replaces a transformer for isolating equipments with and

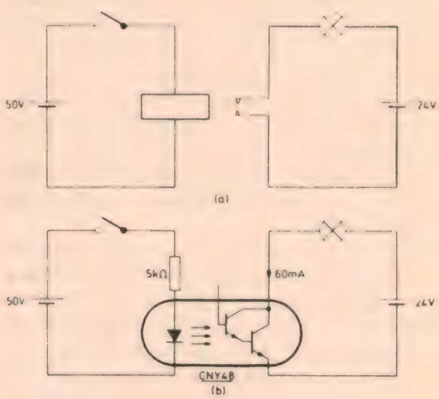


Fig. 3: Direct replacement of relay by an opto-coupler.

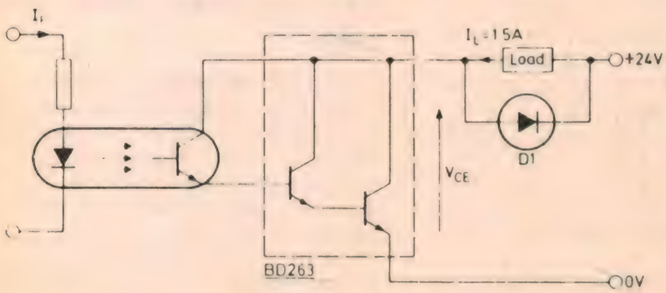


Fig. 4: Protection of low power logic circuitry from relay switching transients using an opto-coupler.

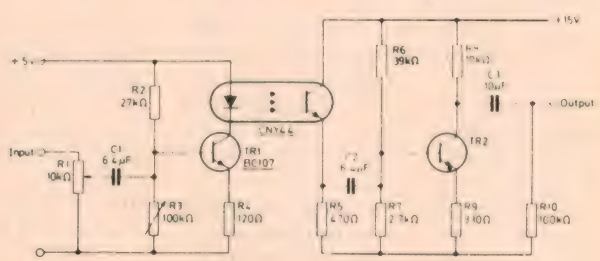


Fig. 5: A practical isolator circuit for coupling audio and other analog signals below 80kHz.

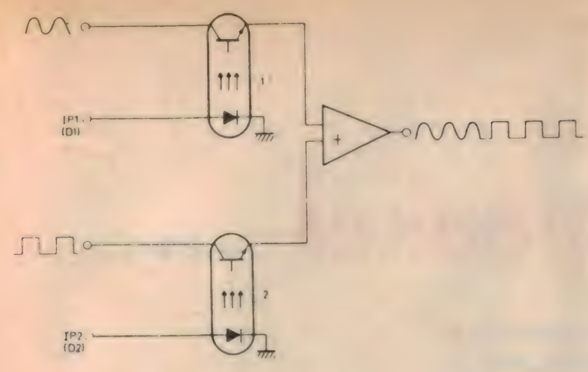


Fig. 6: Two opto-couplers used with an operational amplifier to function as an analog multiplexer. The switching signals remain referenced to ground, while the actual switches "float".

without earthed chassis.

Fig. 6 shows a schematic arrangement where photocouplers are used in an analog multiplexer. The advantages of using photocouplers are that the phototransistors float in the analog signal lines but the gating IR diodes operate with respect to fixed potentials. In Fig. 6, when the IR diode of photocoupler 1 is turned on at IP_1, and the IR diode of photocoupler 2 is turned off at IP_2, the sinewave appears at the output of the amplifier. Alternatively, with the diode of photocoupler 1 off and that of photocoupler 2 on, the squarewave appears at the output. With both diodes on, the resulting signal at the amplifier output is the sum (or difference) of the two transistor input signals.

Overcurrent sensor

A photocoupler can be used as a simple, fast overcurrent sensor in a power supply circuit. The basic circuit is shown in Fig. 7. The IR diode of the photocoupler does not conduct until the voltage across the shunt reaches the knee of the IR diode forward characteristic ($\simeq$1.5V), when the diode current increases rapidly. Diodes D1 to D3 with resistor R1 form an overcurrent bypass

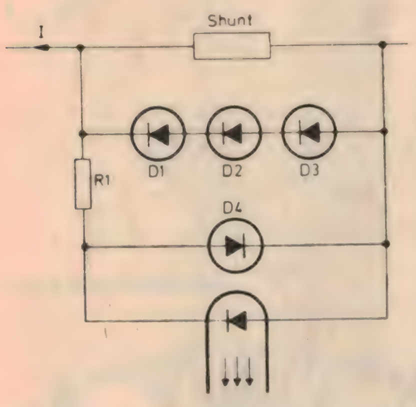


Fig. 7: An opto-coupler may be used as an overcurrent sensor for power supplies and similar circuits, as shown.

network. These diodes should be silicon types with $V_f \simeq$ 0.7V and sufficient current rating for the application. Diode D_4 protects the IR diode from possible reverse voltages.

Series resistor R1 should be chosen so that the IR diode passes sufficient current before the combination of the IR diode forward voltage ($\simeq$2.1V) and the drop across R1 causes diodes D1 to D3 to conduct. The circuit will also operate well on AC but then D1 to D3 should be replaced by two similar networks connected in inverse-parallel.

I think you'll agree that this information from Philips gives a good idea of the many applications of opto-couplers.

To conclude this month, there is news of a new bucket-brigade analog delay line device. It is also from Philips, so that this firm is now able to offer two such devices—the MN3001 which they released a few months ago (see our article in the December, 1975 issue), and the new one.

The new bucket brigade delay line is designated type TDA1022. A monolithic dynamic shift register in MOS technology, the TDA1022 is intended for analog signal processing and can provide a delay from 51.2ms to 0.512ms as the clock frequency is varied from 5kHz to 500kHz.

A special feature of the new device is the low attenuation of only 2.5dB at 25°C. This enables a number of devices to be connected in cascade to obtain long delays without undue losses. The input voltage range is typically 2.5V, when the total harmonic distortion is only 0.6%. The signal-to-noise ratio of a typical device is 70dB.

The TDA1022 is intended for both consumer and professional applications. Reverberation effects, variable compression and expansion of speech in tape recorders, and vibrato and tremolo effects in electronic organs and musical instruments are a few examples of consumer applications. In the professional sector, equalizing speech delays in public address systems, speech scramblers, and timescale conversion multiplex systems in telephony, including linked compander and expander systems, are typical applications of the TDA1022.

The TDA1022 is designed for operation at ambient temperatures from -20°C to +55°C, and is supplied in a 16-pin plastic DIL encapsulation. (J.R.)

For further data on devices mentioned above, write on company letterhead to the firms or agents quoted. But devices should be obtained or ordered through your usual parts stockist.

Build your own electrostatic loudspeaker — PART 2

Following the constructional details of electrostatic speaker units, in the previous article, this article discusses the number of units required, the method of mounting and interconnection and, finally describes an amplifier system with an active crossover network to feed both bass and electrostatic speakers.

by A. A. RENDLE*

Having mastered the construction of individual units, it remains to make the best use of them in a complete system. The three main questions are: (a) how many units are needed? (b) how should they be arranged? and (c) how do we drive them?

The polar response (directivity) of a sound source is determined by its shape and size in relation to the frequency of the signal it is radiating. Fig. 9 shows the polar response of a line source, as a function of length and wavelength. The effective length of our electrostatic unit is about 75mm which, at 10kHz, is about three wave lengths and this gives a very narrow polar response. All the sound, at this frequency, would be radiated in a narrow beam.

A good way to overcome this problem, is to arrange a number of units in an arc, as in Fig. 10. This will give a polar response, at different frequencies, of the general pattern shown in Fig. 11. The ripple pattern is caused by interference between the units, and does not matter if the amplitude of the ripple is kept reasonably small. For the best overall polar response, over a range of frequencies, the arc should be as wide and shallow as possible, implying a large number of units.

The prototype system (Fig. 10) uses 8 units, with a radius of 500mm which gives an arc of just over 90 degrees. As can be seen from Fig.11, this gives good dispersion over an angle of 60 degrees, from about 1kHz up. Below 1kHz, the polar response is filled out by the bass speaker.

Another possible arrangement would be to stack the elements vertically, with each element pointing in a slightly different direction. An angle of 15° between elements would be about right. This has not yet been verified in practice. Yet another method uses a combination of horizontal and vertical stacking: an arrangement apparently favoured by Janszen.

The elements are combined into an array by taping them on to a strip of 25mm thick soft polyurethane foam; the sort used for chair cushions. Use plastic insulating or masking tape. When installing the array, the foam faces inside. The foam does two important jobs: as well as supporting the elements, it provides an acoustically resistive load, to control the main diaphragm resonance.

All the elements are simply wired in parallel, i.e. each of the three terminals on an element are wired to the same terminals on the other elements. The best way of doing this is to make up a wiring harness with solder lugs at the appropriate points for attaching to the terminals. Don't put the lugs on the terminals and then solder the wire, as the heat may damage the plastic. When fit-

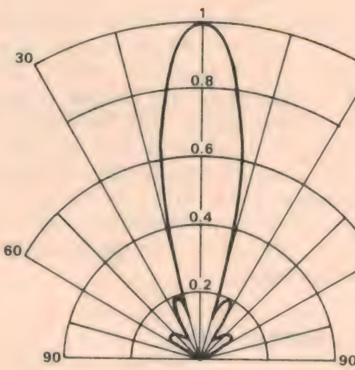


FIG. 9 LENGTH = 3

Fig. 9. Polar diagram when speaker is 3 wavelengths long. ("Elements of Acoustical Engineering" by Olsen.)

Right: Fig. 10. How eight units are arranged in an arc to give maximum spread with minimum mutual interference.

FIG 10 DIMENSIONS IN MILLIMETRES

Below: Fig. 11. Typical polar diagrams produced by multiple units mounted on a 90° arc. The diagram on the left represents the case where arc radius is twice the wavelength, and that on the right a radius of eight times the wavelength. ("Elements of Acoustical Engineering" by Olsen.)

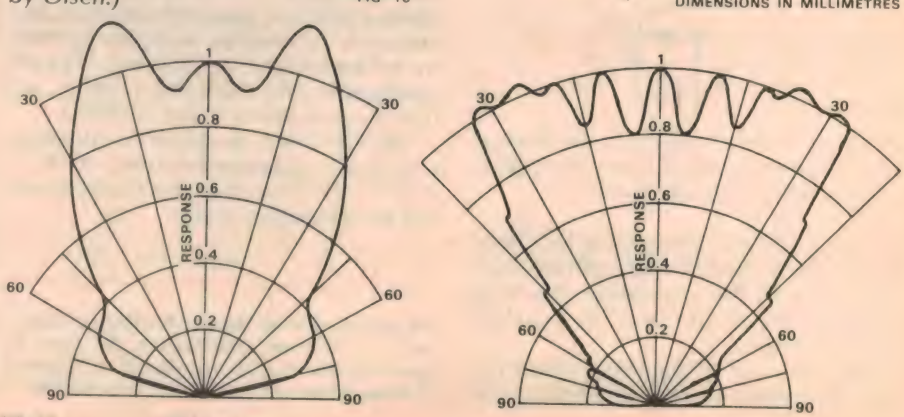


FIG. 11 RADIUS = 2λ RADIUS = 8λ

* 82 Bible St., Eltham, Victoria 3095

ting the solder lugs to the terminals, tighten the nut well and use a shakeproof washer.

The electrostatic array can either be free standing above the bass enclosure, radiating back and front, as in the Bowers and Wilkins Model DM 70, or it can be mounted in a closed absorbent cavity. Both were tried in the prototype system and, in the end, the closed arrangement was preferred. This avoids reflections, off the walls, from the rear radiation, which tends to confuse the stereo image. If the speaker was standing in front of hanging curtains, or some other absorbent material, this would not be a problem.

If you follow the closed approach, the sealed cavity would just be a section of the bass enclosure. The depth should be at least 200mm, and it should be fitted with a wedge of absorbent wadding, such as glass fibre. The dimensions of the prototype enclosure are shown in Fig. 13.

We have now covered the construction of an electrostatic array, which will cover the range from about 400Hz to over 20kHz. The remaining problems are concerned with a suitable bass speaker, and an amplifier to drive the whole system.

Any good moving coil system may be used with the electrostatic speaker. The main thing is to choose an arrangement which will do full justice to the potential quality of the electrostatic speaker. The actual choice of a unit and enclosure will depend on the level needed for the particular room, and how low you want to make the low frequency cut off. For a large room, 300mm or 380mm speakers are recommended. Another very interesting possibility would be to combine a low frequency horn with the electrostatic array; this could give superb results.

In the prototype system, 300mm Goodmans Audiom 61s were used, in large vented brick enclosures, but any similar bass speakers, such as the Philips 12100/W8, would serve well. The Philips speakers have a free air resonance of 15Hz, and will work well in a sealed enclosure of 50 to 100 litres.

With the variety of excellent integrated and hybrid circuits around these days, life is made very easy for people building their own amplifiers. The system used here is merely an assemblage of several well known and popular circuits. Separate power amplifiers are used to drive the electrostatic and bass speakers via active crossover filters: the so called electronic crossover arrangement. Using hybrid power amplifiers, the extra cost is not very great, and the problems of designing and building LC crossover filters between the power amplifier and the speakers are avoided.

The preamplifier (Fig. 14) uses the still unsurpassed National LM 381, followed by a passive tone control circuit and an LM 301A operational amplifier, arranged to give a gain of 10. The gain is determined by the ratio of Rb to Ra. If you

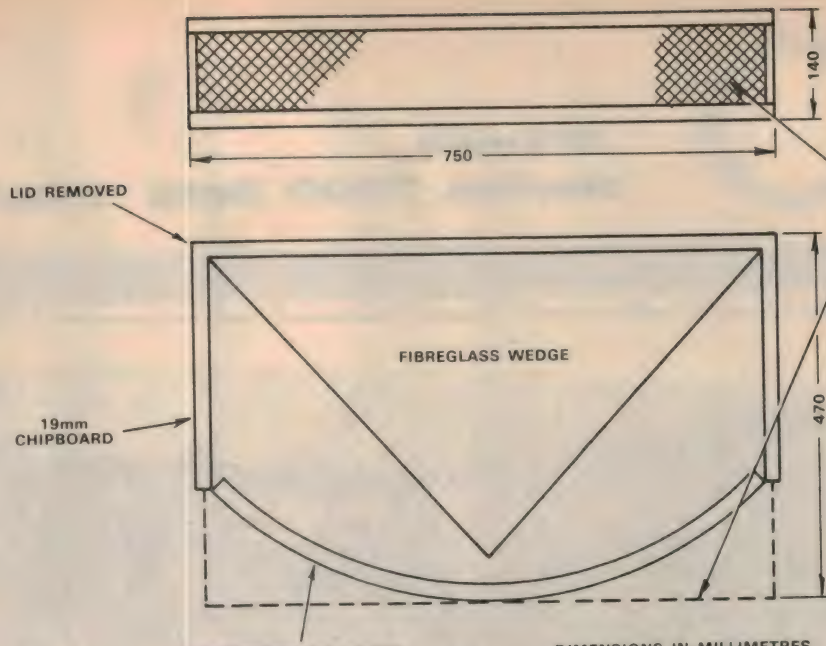
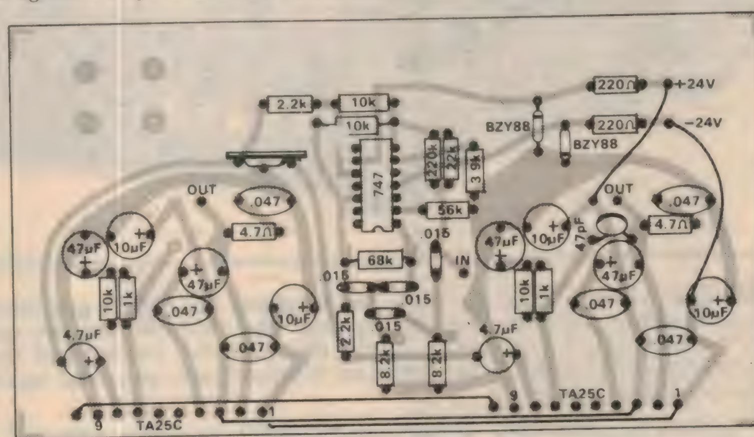


FIG. 13

Fig. 13. Details of the closed absorbent cavity used for the electrostatic units. Note the fibreglass wedge in the rear of the enclosure.



Component layout of the printed board, shown from the component side. The high frequency amplifier is on the right and the low frequency on the left.

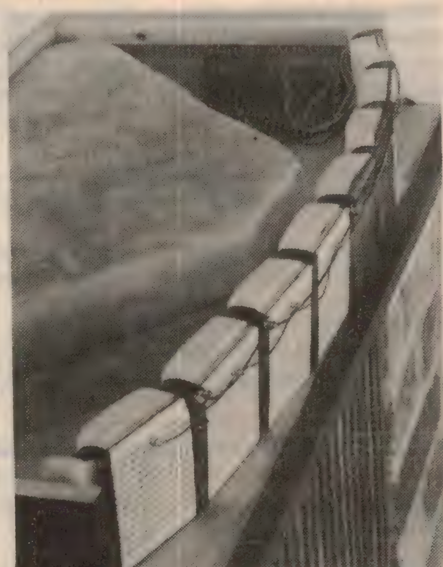


Fig. 12. Electrostatic speaker cavity, with cover removed, fitted to the top of the brick bass vented enclosure.

need more, or less, gain, the value of Ra or Rb may be altered to give the required ratio.

The active crossover filters (Fig. 15) were described in the April, 1972, issue of Audio, by Michael W. King. The arrangement is particularly neat and economical. A high pass filter is used to feed the electrostatic speaker power amplifier, while the complementary low pass filter is derived by taking the sum of the input and output of the high pass filter. This gives, in effect, the low pass filter. With the component values shown, the crossover frequency is about 530Hz. Alternative values of C_0 are given in Table 1, for different crossover frequencies.

STC Type TA 25C (also sold as Sanyo Type STK 032) thick film hybrid circuits were selected for the power amplifiers (Fig. 15). A small capacitor is added to the feedback path on the amplifier driving the electrostatic speaker, to control slight ringing, due to the capacitive load. A full array of 8 elements reflects a load of about 2 microfarads, and requires a

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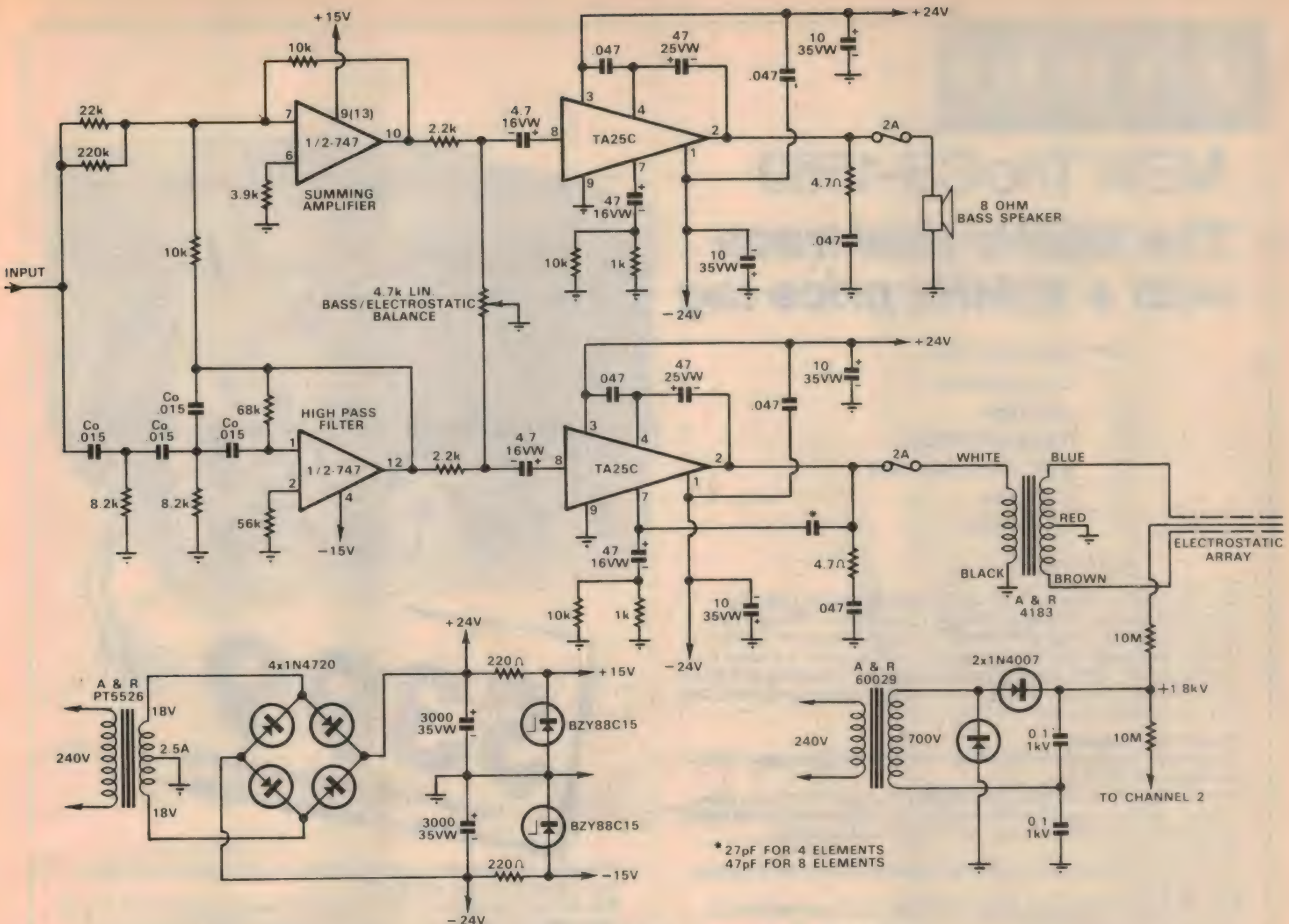
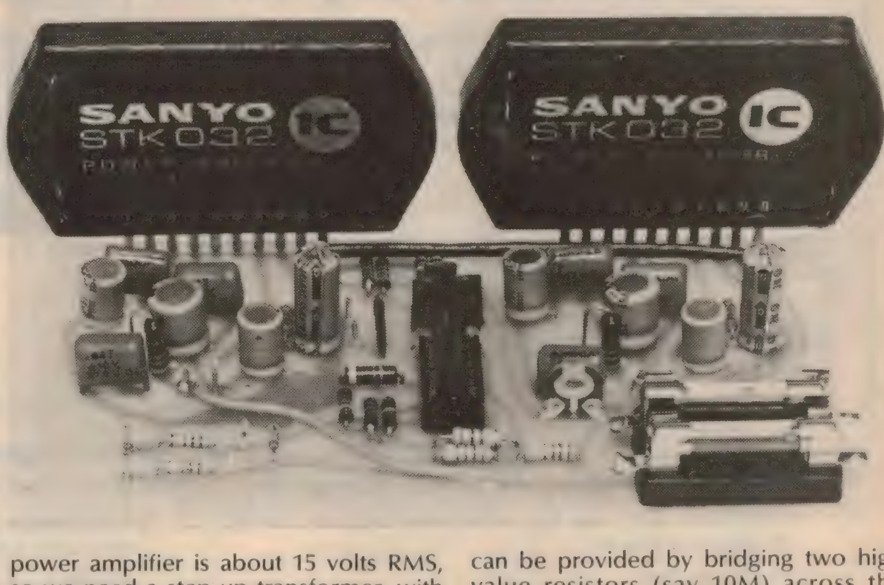


FIG 15 CROSSOVER, POWER AMPLIFIERS AND POWER SUPPLY

Above: Fig. 15. Circuit of the power amplifier and crossover network, one channel only. Note the use of a high pass filter to feed the electrostatic speaker amplifier, and a summing amplifier to feed the bass speaker amplifier.

Below: Complete power amplifier board. The high frequency amplifier is on the left, and the bass on the right.



capacitor of 47 pF in the feedback path. If fewer elements are used the capacitor should be reduced in value: four elements require 27 pF. Not all power amplifiers are happy driving into a capacitive load, so if an alternative circuit is chosen, its stability under these conditions will need to be checked. The hybrid ICs must be bolted to a heat sink or chassis.

Hz	Co (μF)	Hz	Co (μF)
100.00	0.07958	1258.93	0.00632
125.89	0.06321	1584.89	0.00502
158.49	0.05021	1995.26	0.00399
199.53	0.03988	2511.89	0.00317
251.19	0.03168	3162.28	0.00252
316.23	0.02516	3981.07	0.00200
398.11	0.01999	5011.87	0.00159
501.19	0.01588	6309.57	0.00126
630.96	0.01261	7943.28	0.00100
794.33	0.01002	10000.00	0.00080
1000.00	0.00796		

Table 1—Capacitor values for active filter network.

The electrostatic speaker needs a peak drive of about 1000 volts RMS, to match the sound output of a 300mm bass speaker. It also needs a polarizing supply (see below). The maximum output of the power amplifier is about 15 volts RMS, so we need a step up transformer, with a ratio of 1:70. A transformer specifically designed for the application is the A and R Type 4183.

The secondary winding should be centre tapped, as shown in Fig. 15, but if you have a transformer with the right ratio, but no centre tap, an artificial tap can be provided by bridging two high value resistors (say 10M) across the secondary. Another possibility is to use an old output transformer from a push pull valve amplifier.

A polarizing supply in the region of 1.5kV is needed to charge the electrostatic speakers. The higher the voltage, the more sensitive the speaker will be.

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But if too high a voltage is used, the system is likely to break down, and spark across, somewhere. In practice 2kV seems to be about the limit.

In the prototype system, an old valve type mains transformer, with a 350-0-350 volt secondary, was used. With a voltage doubler (see Fig. 15), the output is about 1.8kV. A commercial transformer, the A&R 60029 is also available. The polarizing supply must be connected via a high resistance (at least 10M), for safety.

The ±24 volt supply for the power amplifiers is straightforward, using an 18V-0-18V transformer, such as the A&R PT5526. Zener diodes are used to provide ±15 volt for the earlier stages.

The relative sensitivities of the bass and electrostatic speaker/amplifier combinations are adjusted with the balance control on the inputs of the power amplifiers. Ideally, this would be done using a signal generator and sound level meter, but it seems possible to get a good balance by ear. Using a variety of records, or other program source, adjust the balance control, for left and right channels in turn, until the balance seems right.

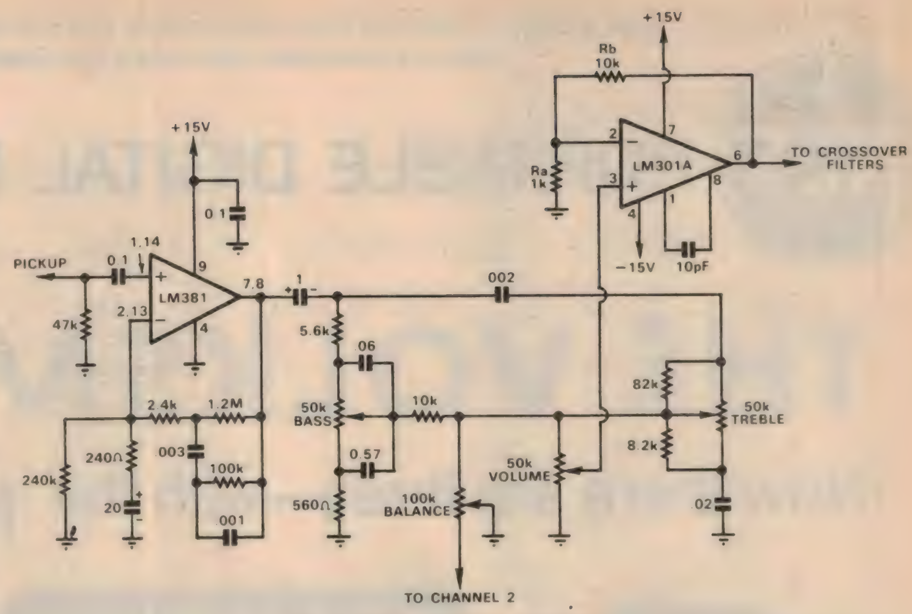
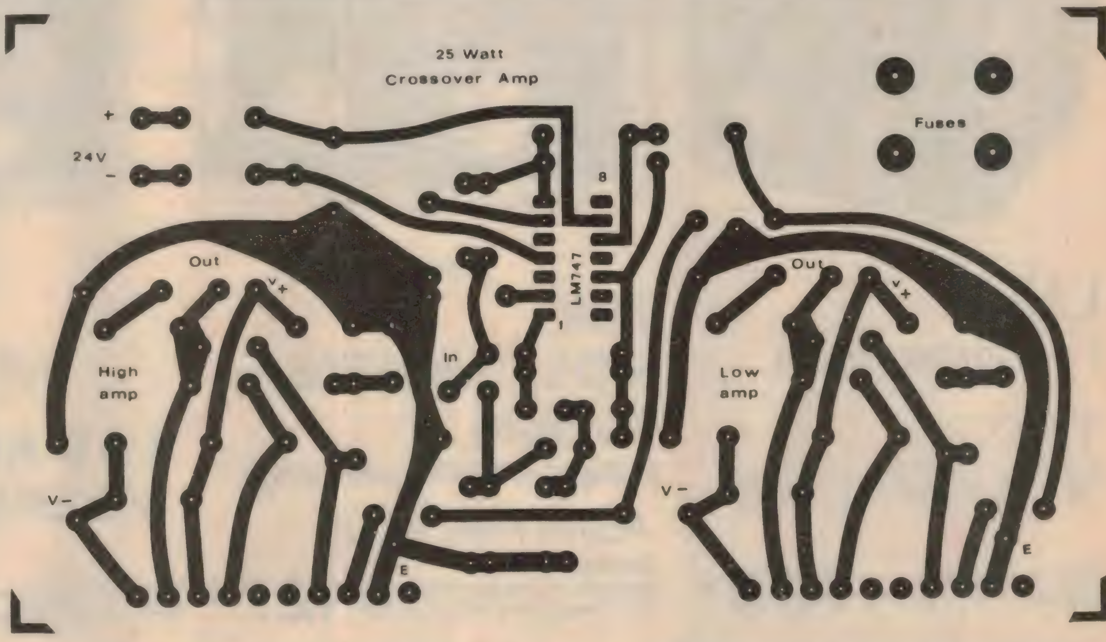


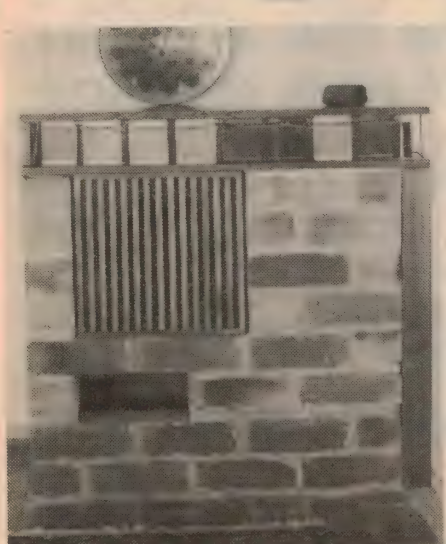
FIG. 14 PREAMPLIFIER (FINAL VERSION)

Fig. 14. Circuit of the preamplifier. The gain can be varied by varying the feedback resistors, Ra, Rb, associated with LM301A. Values shown give a gain of 10.

Right: The printed board pattern, shown actual size. Ready made boards should be available from suppliers when this article appears.



Below: The author's brick enclosure with electrostatic system above it. ". . . gives a lot of satisfaction on everything from Suzi Quatro to Bartok!"



The author's own system, as described above, has evolved over a number of years, as the design of the electrostatic elements developed. The rest of the system consists of a Shure V-15 Type III pick-up cartridge, in a Lustre arm, modified to get rid of excess mass, and a JH turntable. With this combination, the whole system gives a lot of satisfaction on everything from Suzi Quatro to Bartok! The clarity of detail on orchestral music is very good, and string tone is smooth and silky.

The system has plenty of power in reserve, so that a high listening level can be used, without overloading on peaks—this is essential in any really good system. In conclusion, the author hopes that anyone having a go at making their own electrostatic speakers, as a result of these articles, will get as much fun and satisfaction out of the project as he has had!

FURTHER READING:

1. "Electroacoustics", by F. V. Hunt, Harvard University Press, and J. Wiley and Sons, 1954, pp. 167-212, 202, 205.
2. "Wide Range Electrostatic Loudspeakers", P. J. Walker, Wireless World, May, June, August, 1955.
3. "Horn-Load Electrostatic Loudspeaker", Josef Merhaut, Journal of the Audio Engineering Society, November, 1971.
4. "Full-Range Electrostatic Loudspeakers", H. J. Leak and A. B. Sarkar, Wireless World, October, 1956.
5. "An Electrostatic Loudspeaker Development", Arthur A. Janszen, Journal of the Audio Engineering Society, April, 1955.

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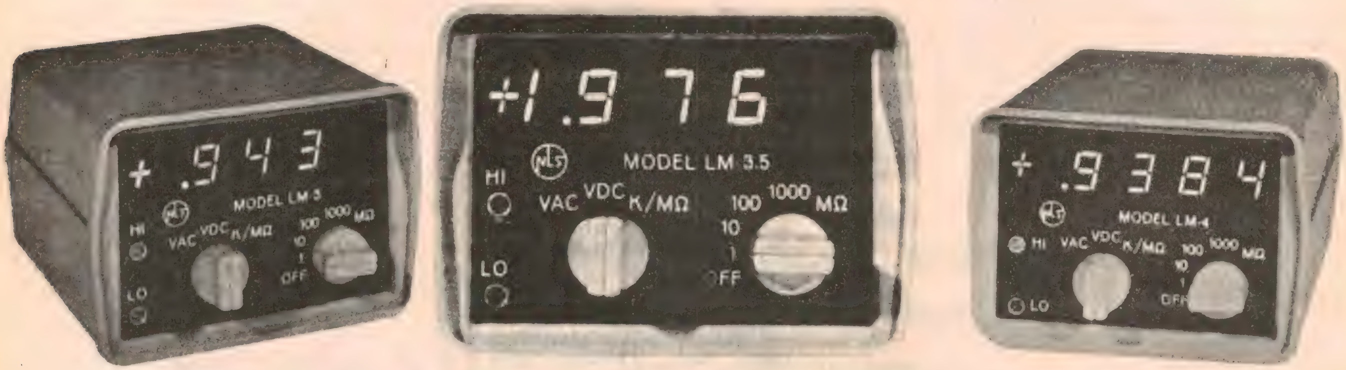

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Circuit & Design Ideas

Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

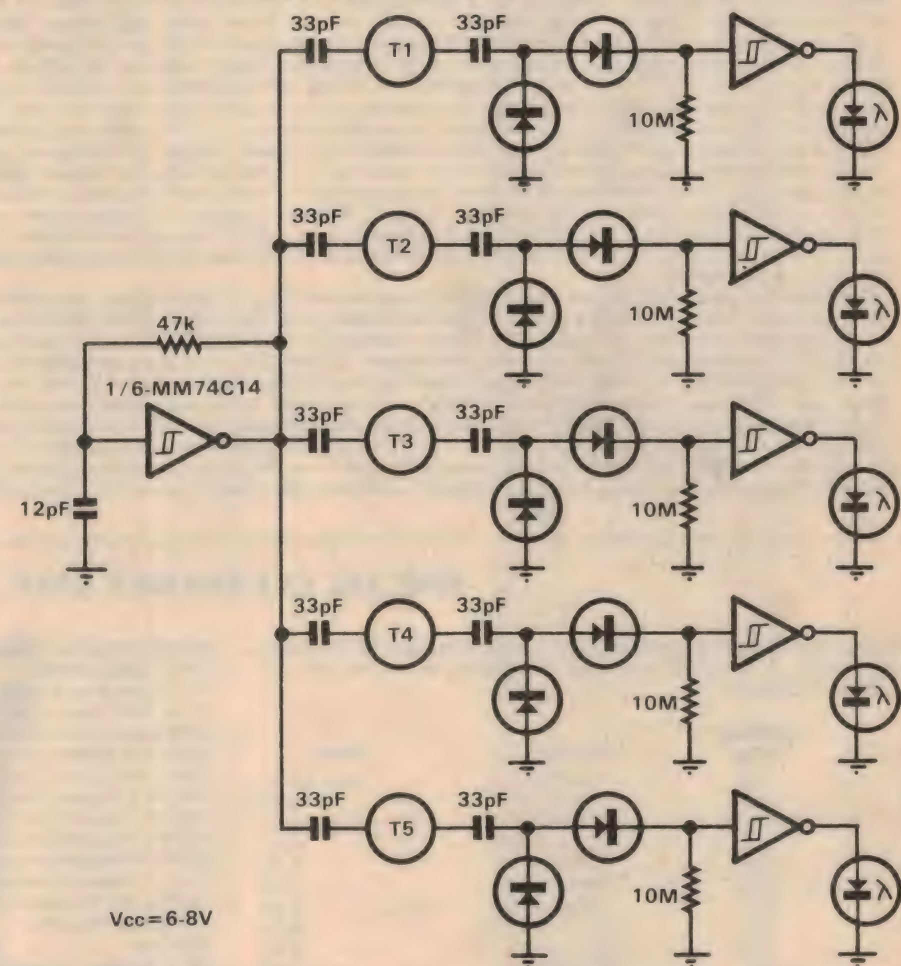
Application for 74C14 CMOS Schmitt trigger

National Semiconductor has just recently added a new CMOS IC to its range. The package consists of six Schmitt triggers and is designated the 74C14. It offers the advantages of low supply current and infinitesimal input loading, available only from complementary MOS.

The circuit for CMOS Schmitt trigger oscillator is remarkably simple, as may be seen from the diagram. The diagram shows an application how the output power from a Schmitt oscillator running at about 400kHz, is fed to five touch switches. Note that the metalwork of the touch switch is isolated from the circuitry by the dielectric of the ceramic capacitors. This is an important safety point. A reasonable ground plane is essential for efficient dipole action by the body, to the finger that is touching the touch plate.

With no finger applied to touch pads T1-T5, sufficient energy is transferred to the input capacitance of the CMOS Schmitt triggers to keep them well above the switching voltage VTL. However, application of a finger absorbs sufficient energy to allow the 10M bleed resistor to pull an input below VTL. In the demonstration model, we have the output driving a LED directly as a visual indication. In a system application, logic 'one' level indicates an active switch. Remove the finger and the lamp is extinguished—the logic level goes to zero.

Variations of the circuit which come to mind are feedback matrices to cause latching and/or exclusivity. Such approaches are useful in touch-button tuning for FM station preselectors or TV tuners.

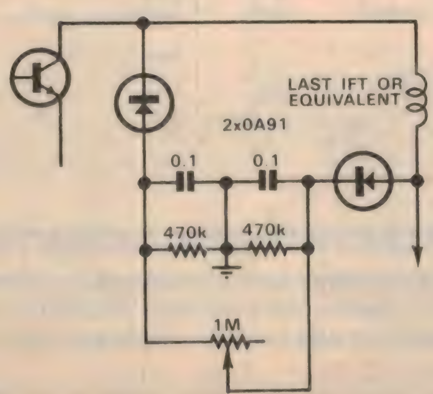


(By Richard Percival, National Semiconductor.)

Try this IF noise limiter

During development work on a VLF receiver the need arose for some sort of noise combating device. The usual search for and trial of various circuits was undertaken and finally I came across this one which met the need for a simple yet effective noise limiter.

The circuit is not unlike the "Bishop" IF noise limiter and it is possible that the circuit which I have used may have stemmed from the Bishop. It appears to have been first described many years ago by VK3ZCN and so it is not new or original as far as I am concerned. Sometimes a good circuit lies hidden and little used by a majority of people who may be able to use it to advantage and it is for this reason that I am including it in these columns.



In its original form, the noise limiter used a 6AL5 twin thermionic diode and I have replaced it with two OA91 diodes. Germanium appears to be superior to silicon in that clipping is more effective. The amount of clipping is minimum with all of the 1M potentiometer in circuit, with maximum clipping when shorted.

(By Ian Pogson, "Electronics Australia".)

A COMPUTER CONCEPT BECOMES AN EXCITING REALITY

In January of 1975, MITS (Micro Instrumentation & Telemetry Systems) stunned the Computer world with the announcement of the Altair 8800 Computer that sells for under $500 in kit form. The Altair 8800 is a superbly engineered, variable word length computer. Its byte orientation structure was designed to give the Altair the most efficient utilization possible—an efficiency only found in the most advanced computers. It has a cycle speed of 2 microseconds; it can directly address 65k bytes of memory and 256 input/output devices; and it has 78 basic machine instructions with variations over 200 instructions. The Altair 8800 has been designed with buss orientation to be easily expanded and easily adapted to thousands of applications. It is ideal for the hobbyist who wants to get involved with computers. Yet, it has the power and versatility for the most advanced data processing requirements. Its basic memory of 256 words of static RAM memory can be expanded to 65,000 words of directly addressable memory, static or dynamic memory, PROM or ROM memory, or a floppy disc system which can store over 300,000 bytes of information on a flexible disc with a data transfer rate of 250K bits/sec. Using standard MITS interface cards the Altair 8800 can be connected to MITS peripherals (computer terminals, line-printers, audio-cassette interface, character alpha numeric display, teletype, etc). **TODAY MITS IS ANNOUNCING THE ALTAIR 680 COMPUTER** for under $350 in kit form, plus freight. The Altair 680, built around the revolutionary new 6800 microprocessor chip, it is the lowest priced computer on the market. The Altair 680 comes with power supply, front panel control board, and CPU board inclosed in a case. In addition to the 6800 processor, the CPU board contains the following; 1) 1024 words of memory. 2) Built-in Interface that can be configured for RS232 or 20mA Teletype loop or 60mA Teletype. 3) Provision for 1024 words of ROM or PROM. The Altair 680 can be programmed from the front panel switches or it can be connected to a computer terminal or Teletype. With a cycle time of 4 microseconds, 16-bit addressing, and the capability of directly addressing 65,000 words of memory and a virtually unlimited number of I/0 devices. It can be expanded to an advanced custom intrusion system, programmable scientific calculator, automatic IC tester, complete accounting system, sound and light controller, or it can be all of these things at the same time. The list of applications is literally endless. See WHK Catalogue for details on both computers, also listed in the same catalogue price reductions on modules for the Altair 8800, 4K memory boards under $220, etc. All units come with complete documentation. Manuals with circuit diagrams can be purchased separately.

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J	4-8	6 sets N.C.	0.40
K	18-24	6 sets N.C.	0.40
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M	15-30	6 sets N.C.	0.40
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O	15-30	4 sets N.O., 1 change over	0.70
P	12-24	2 sets change over	0.80
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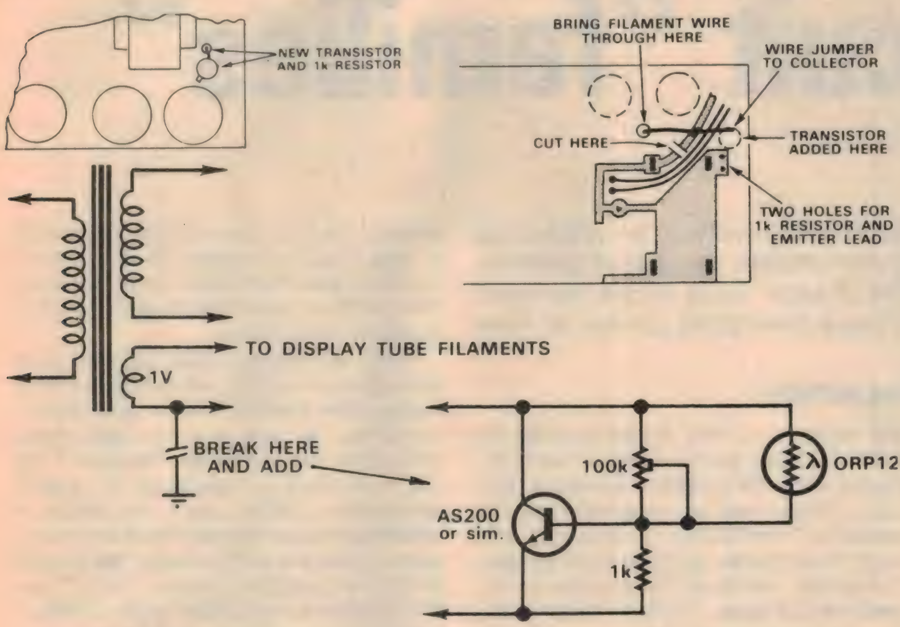


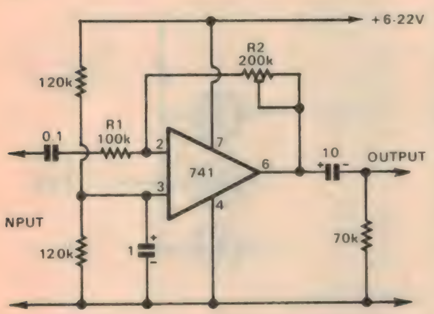
Having built the LSI Digital Clock as described in April, 1975, the follow-up article describing a Quartz Crystal Drive for it in September, 1975, prompted me to suggest a very simple modification which I have incorporated into my clock and may be of interest to other readers.

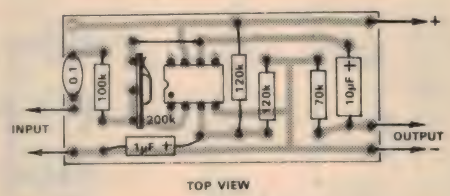
I built my clock for use in the bedroom but I found it much too bright at night. After trying a number of ideas, I arrived at the following variable intensity circuit which has been very successful. The circuit was added between the display tube filament connections and the main board earth. The hardest part was to find somewhere to fit the parts.

The CdS cell was fitted through a hole in the back panel, just behind the power transformer, facing backwards and receiving only ambient light. The preset potentiometer is mounted across the LDR terminals and held in place with a dab of epoxy resin. The earth for the tube filaments is cut to the right of the transformer fixing point as shown in the diagram. The filament wire is lifted carefully from its earth pad, extended, and by drilling a small hole in the board it is then soldered to the filament line next to the cut copper track. The AS200 transistor and the 1k resistor are mounted next to the power transformer as shown and connected to the LDR by a short twisted pair. After assembly the 100k potentiometer is adjusted to give a satisfactory minimum brightness in a dark room.

(By Mr A. G. Briggs, 580 Lowe Street, Hastings, N.Z.)

General purpose amplifier uses uA741c IC





Here is the circuit and PCB layout of a general purpose interstage amplifier using the uA741c integrated circuit. The unit may appeal to readers looking for a small interstage amplifier to be fitted into limited space. I used the unit to boost preamplifier output (nominally 250mV) to drive fully hybrid amplifier units calling for 500mV input.

The circuit is not particularly original but the advantage of this version lies in its small size, minimum number of components, negligible distortion, simply adjusted levels of amplification and may be operated over a wide range of supply voltages.

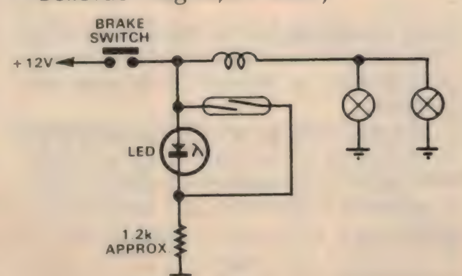
(By Mr W. Hansen, C/o University of Canterbury, Christchurch, NZ.)

Different brake light warning indicator

In "Electronics Australia" for March, 1972 (p80) and May, 1972 (p82) a very useful brake light warning indicator was described.

After some experimenting this is the circuit which I settled for. A LED is connected in series with 1.2k and the LED is shorted out under normal conditions. This appears to work satisfactorily and it gave an indication when one lamp was removed and the brake pedal was operated. I prefer this mode of operation to that described in the original articles.

(By R. Blackwell, 22 Glenwood Drive, Bellevue Heights, SA 5050.)



An Introduction to Digital Electronics—3

Logic circuit "families"

A number of different technologies have been evolved for producing circuit modules, and "families" of circuit modules, capable of performing often required logic functions. This chapter looks at the common logic families, and explains how they were developed as well as how they work.

by JAMIESON ROWE

In this chapter we are going to digress for a while to look at some of the types of practical circuitry which are commonly used nowadays to perform logic functions. Hopefully this will let you put basic digital theory and practice into perspective, before we go further into the subject.

As we saw in the preceding chapter, the basic logic functions can be performed simply using mechanical switches. The very earliest digital logic circuits in fact used this approach, dubbed for convenience "switch logic".

While adequate for simple circuits and systems, switch logic proved to have quite serious drawbacks. In particular, it called for very complex switches whenever the logic "input" from a switch was required to be effective in a number of different parts of the circuit.

A way around this was to supplement switches with relays, which could be used to effectively multiply the number of switches poles available. Thus was born "relay logic".

While relays can provide the required number of poles, they share with switches the problem of unreliability and mechanical contact "bounce". This together with the relatively long time taken for a relay to operate has tended to restrict switch and relay logic to those applications where only a very low speed is required. Examples are the control of traffic lights and building elevators (lifts).

When the limitations of switches and relays became apparent, logic circuit designers tried other approaches. One was to use small lamps and light-sensitive resistors, giving "opto-electronic logic" (Fig. 1(b)). This avoided the unreliability and contact bounce of relays and switches, but didn't offer much else. The speed of operation was still quite low, due to the thermal lag of the lamps and the resistive lag of the photoresistors.

The first real breakthrough came with the development of diode logic. This used semiconductor diodes, in conjunction with pull-up and pull-down resistors. Using suitable combinations of diodes and resistors, it was found possible to produce simple gates capable of performing the AND, OR and other functions (Fig. 1(c)). These had no moving parts to produce unreliability or bounce, and could thus operate at quite high speeds. The diodes introduced losses due to forward voltage drop, but these could easily be compensated using transistor amplifiers. Simple transistor inverters could also be used to perform the NOT function where required.

Not long after diode logic came resistor-transistor logic, or "RTL" for short. This

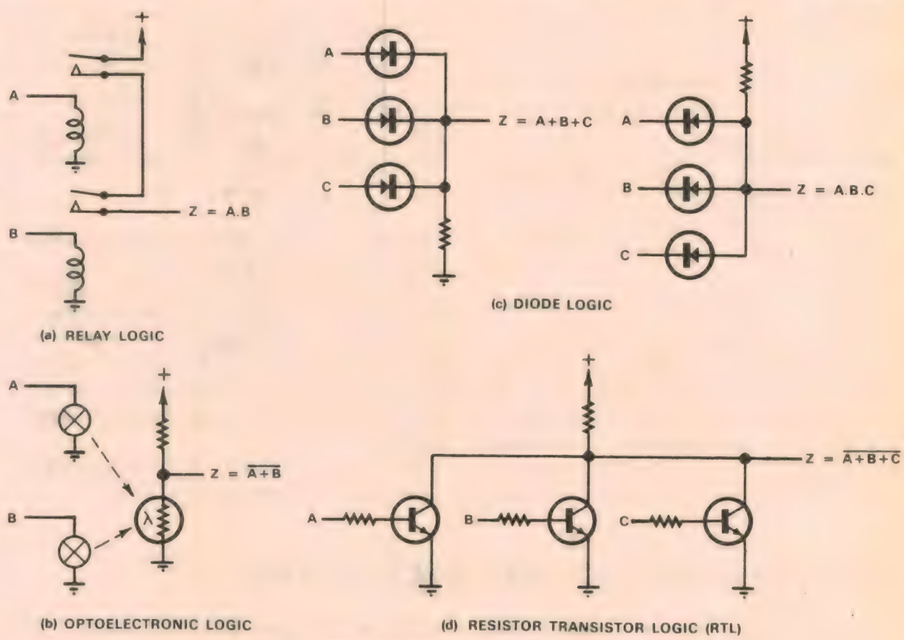


FIG. 1 : EARLY TYPES OF LOGIC

used combinations of transistors (Fig. 1(d)), with resistors as loads and input current limiters, to perform both logic and inversion.

RTL was the first type of logic to be used in integrated circuit logic modules, which first appeared on the commercial market at about the beginning of 1966. At first there were only three modules, but as time passed other useful modules were added to form a complete "family" of RTL devices. Each of the modules performed a useful and commonly required logic function, and all modules were designed to be electrically compatible with the other members of its family.

Many worthwhile logic systems were designed around RTL, which offered quite respectable performance coupled with reliability, low cost and uncritical signal and circuit requirements. However it did not lend itself to operation at speeds above about 4MHz, due to the effects of transistor charge storage and stray capacitance across the load resistors. As a result designers gradually turned away from RTL to other forms of logic as the demand grew for logic circuits capable of operating at higher speeds.

The next logic family to come into prominence was transistor-transistor logic, or TTL for short. This has been an extremely popular family of logic modules, and grew from a relatively small number of "basic gate" devices to encompass hundreds of different devices, including medium-scale integration or "MSI" types containing functional subsystems and large-scale integration or "LSI" types containing complete systems.

The basic TTL gate is shown in Fig. 2(a). It is virtually a further development of the second diode logic gate shown in Fig.

1(b), with a multi-emitter transistor replacing the diodes. A second transistor is used as an output buffer and inverter. If all of the input emitters are held at the "high" voltage state, the current flowing into the input transistor's base flows out the collector, and biases the output transistor into conduction so that its collector goes low. But if any of the input emitters is taken low, this provides a "sink" for the base current, and the output transistor is turned off. Its collector voltage thus rises to the "high" state.

If we choose to regard the "high" voltage state as logic true (1), and the "low" state as logic false (0), the gate thus performs the NAND logic function, with the output false only when all inputs are true.

Practical TTL gates are a little more complicated than this, with additional transistors and other components to increase operating speed and give improved reliability. The first practical TTL devices to appear were the well-known "54/74" series, originated by Texas Instruments. The basic circuit for a 7400 series gate is shown in Fig. 2(b). If you compare it with the basic gate, you will see that the main difference is the addition of a pair of "totem-pole" output transistors to increase the operating speed and the output current capability. Clamp diodes are also added to the inputs, to prevent damage to the multi-emitter transistor from negative-going transients.

A great many 7400-series devices based on this circuit have been produced, and used in vast numbers of highly successful digital systems. However as time progressed, circuit designers began to demand devices with either lower current consumption, faster speed, or both.

In an effort to satisfy the demands for lower current consumption the IC makers produced a family of devices known as "low-power TTL", or LPTTL, with the series designation 74L00. These were based on the same circuit configuration as standard TTL, but with the resistor values increased to reduce the current levels as shown in Fig. 2(c). This also reduced speed, but in many low power applications this was not important.

In order to satisfy those who demanded higher speed, they produced a "high-speed TTL" series, designated 74H00, and also a "Schottky TTL" series, designated 74S00. Like the low-power series these were still based on the original TTL circuit, but here the various resistor values were made smaller to increase speed—at the expense of higher current. With 74S00 devices the transistors were also shunted with metal-semiconductor or "Schottky barrier" diodes as shown in Fig. 2(d), to prevent them from saturating. This obviated charge storage effects, and gave a further marked increase in speed.

The most recent variant of TTL to evolve is a series of devices known as "low-power Schottky TTL", and designated 74LS00. These combine the higher resistor values of low-power TTL with the speed improvement of Schottky barrier clamp diodes across the transistors. As you might guess, they have been evolved to satisfy the demands of those wanting high speed as well as low power dissipation. The 74LS00 series offer roughly the same speed as the original 7400 series, but with the reduced dissipation of the 74L00 series. If not eclipsed by other technologies, this series seems likely to become the "standard" TTL family of the future.

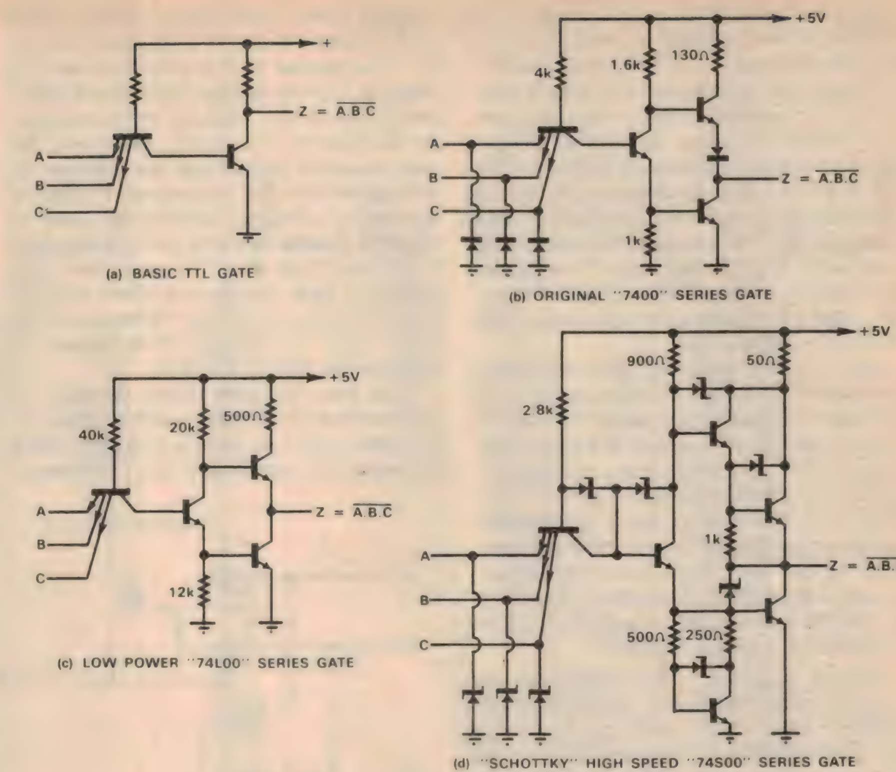


FIG. 2 : VARIETIES OF TRANSISTOR-TRANSISTOR LOGIC (TTL)

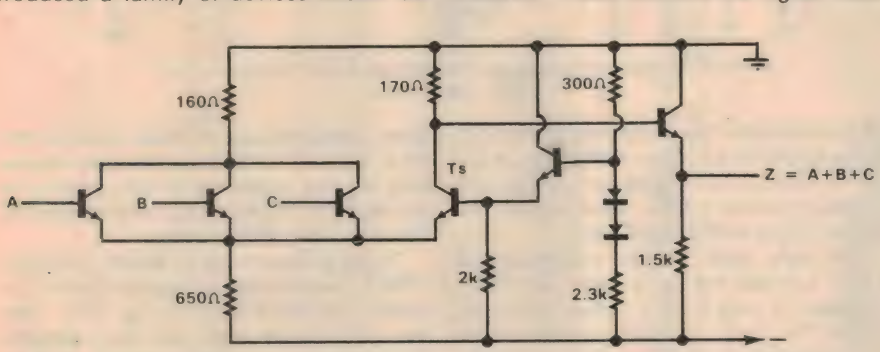


FIG. 3 : EMITTER-COUPLED LOGIC (ECL)

Until the IC makers developed Schottky-clamped TTL, engineers designing very high speed digital systems often found that 74H00 devices were just not fast enough. As a result of their demands for extremely high speed gates and other logic elements, the makers came up with an alternative form of logic called "emitter-coupled logic" or ECL. This used a technique known as current steering, with transistors deliberately kept out of saturation to avoid the slowing-down effects of saturation.

The circuit of a basic ECL gate is shown in Fig. 3. At its heart are a number of input transistors with their collectors and emitters connected together, and with their common emitter line also connected to the emitter of a further transistor Ts. The base of this transistor is tied to a reference voltage, supplied by a temperature-compensated voltage divider and an emitter follower transistor, and its collector is connected to another emitter follower used as an output buffer.

The gate works in the following way. Due to the fixed bias voltage at its base, transistor Ts tends to conduct. This has two effects, one being that the collector current causes a voltage drop across its collector load resistor, and also at the output of the gate. The output of the gate thus goes to its "low" logic level. The second effect of Ts conducting is that it tends to act like an emitter follower, passing sufficient current into the 650ohm emitter resistor to produce a voltage drop about 0.7V less than the base voltage.

This tends to reverse bias the multiple input transistors, so that if the input bases are held at the low logic level, these transistors are cut off. However if any one or

more of the input bases are taken to the high logic level, which exceeds the fixed bias on the base of Ts, then the transistor or transistors concerned are able to conduct. This passes current into the common emitter resistor, tending to raise it above the voltage produced by the emitter current of Ts, and so reverse biasing Ts. Accordingly Ts cuts off, and its collector voltage rises. The gate output voltage also rises to the "high" logic level. If we regard the "high" voltage level as logic "true" (1), this particular gate obviously performs the OR function.

As you can see, the gate effectively works by "steering" the current from the 650ohm emitter resistor either through Ts or through one or more of the input transistors. The operation does not depend upon any of the transistors being saturated, and in fact the gate is deliberately designed so that saturation cannot occur. This allows very high speed operation, and ECL devices are capable of operating at speeds greater than virtually any other technology: beyond 500MHz.

Circuit designers had pressures on them to reduce the power consumption of medium speed logic systems long before the development of low-power Schottky TTL, and as a result many turned away from TTL in an effort to find a technology capable of offering reasonable speed coupled with low power dissipation.

The technology they turned to was MOS technology, based on metal-oxide-semiconductor field effect transistors (FETs) rather than bipolar transistors. There are a number of types of logic circuit based on MOS technology, the three most widely used being NMOS, which uses predominantly N-channel MOSFETs; PMOS, which uses P-channel MOSFETs, and complementary or CMOS, which uses complementary pairs of both.

All three are currently in use at the time of writing, although NMOS and PMOS are used mainly in LSI devices incorporating complete digital systems. The technology mainly used for general-purpose small scale integration (SSI) logic modules is CMOS, which many people have described as the most elegant type of logic circuit to appear to date. It certainly offers many attractive features, including medium speed, very low current drain and low cost.

A basic CMOS gate is shown in Fig. 4(a). This is a two-input gate, and as you can see it uses only four transistors: two P-channel types in parallel at the top, and two N-channel types in series below. There are no resistors or other circuit elements.

The inputs of the transistors are tied together in complementary pairs, and shown, so that with either logic level applied to the inputs, only one transistor of each complementary pair can be conducting at any one time. If an input goes high, its N-channel transistor turns on while its P-channel transistor cuts off, and vice-versa.

If both inputs are high, both of the N-channel lower transistors conduct, while both P-channel upper transistors are cut off. The output of the gate is thus held down at the low voltage level. But if either input is taken low, this cuts off its associated N-channel transistor, breaking the path between output and low voltage. At the same time the associated P-channel transistor conducts, closing the path to the high voltage rail, and taking the output to the high logic level. This condition also applies if both inputs are taken low, so that if we regard the high voltage level as logic "true" (1), the gate may be seen to perform the NAND function.

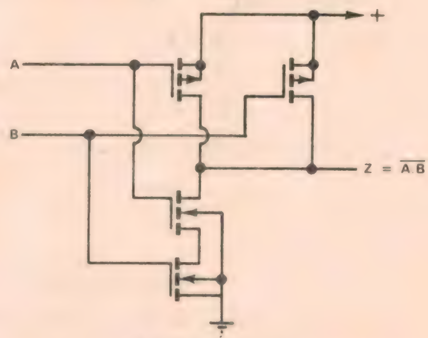
Note that the gate draws virtually no current from the supply in either of its static states, since no conducting path exists between the two supply rails. Whenever one of the upper transistors is conducting, at least one of the lower transistors is cut off. So that a CMOS gate has almost zero quiescent current drain, being an almost perfect static switching circuit.

The only time the two transistors of each complementary pair conduct together is very briefly, when changing states. This is due to differing control voltage thresholds, so that the transistor going into conduction "comes on" faster than the other transistor turns off. This means that each time the gate changes state, it momentarily becomes a low impedance path across the supply, and draws a short pulse or "spike" of current.

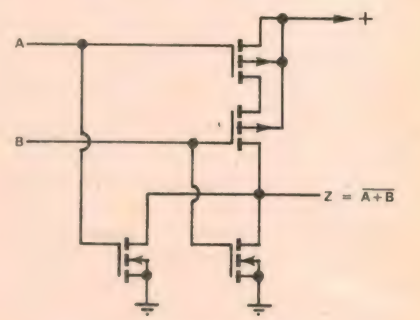
Because of this the average current drain and power dissipation of a CMOS gate under dynamic conditions rise from their very low quiescent levels, in a linear fashion. The power dissipation is still very modest compared with a TTL gate, however, being only about 800uW at 1MHz and 5V supply compared with about 10mW.

A basic CMOS gate which performs the NOR function if the high voltage level is regarded as logic true (1) is shown in Fig. 2(b), for you to compare with the gate just described. As you might expect from logic, it is basically a mirror image of the first gate, with the series and parallel pairing reversed.

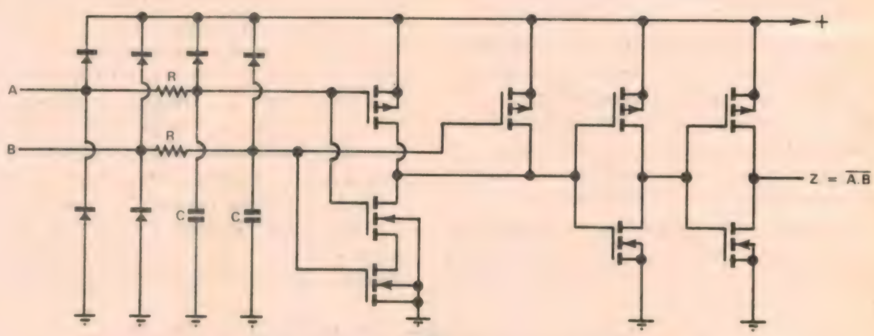
While they perform the required logic functions, the basic CMOS gates shown in Figs. 4(a) and (b) have two main practical disadvantages. One is that the switching characteristic tends to be somewhat poor, giving indecisive switching when input logic levels do not differ by almost the full supply voltage. The other disadvantage is that without any form of input protection, the gate insulation of the transistors can easily be damaged by static charges and transients, like any other MOS devices.



(a) BASIC NAND GATE



(b) BASIC NOR GATE



(c) PRACTICAL NAND GATE WITH INPUT PROTECTION, DOUBLE BUFFERED OUTPUT

FIG. 4 : CMOS LOGIC

To get around these problems, practical CMOS devices tend to have additional circuitry like that shown in Fig. 4(c). Here the output is provided with two cascaded complementary MOS inverter stages, which give a very much sharper switching characteristic. This is known as "double buffering". The inputs are also protected from damage by means of a series R / parallel C transient filter, together with diodes which ensure that the transistor gates cannot be taken more positive than the positive rail nor more negative than the negative rail.

One of the important practical advantages of CMOS, apart from its very low power consumption, is that it can operate over a wide range in supply voltage—

typically from 5 to 15V, but some devices will operate from voltages as low as 1V.

The final type of logic to evolve to date is integrated injection logic (I^2L) or merged transistor logic (MTL), developed independently by IBM and Philips, and announced by both in early 1972. This is a type of logic which reverts back to bipolar transistor technology, but with a difference: like CMOS, there are no passive circuit elements, only transistors.

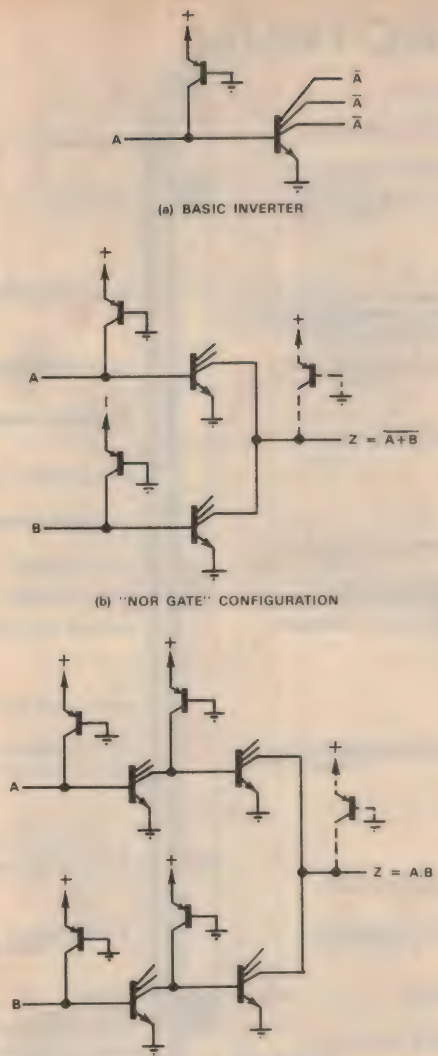
MTL was designed primarily for large-scale integration (LSI), and it is based on a multi-output inverter rather than a free-standing gate. The basic circuit of an MTL inverter is shown in Fig. 5(a).

As you can see, it has no "pull-up" resistors or transistors provided for any of the outputs, which are simply the multiple collectors of a single NPN inverter transistor. Instead, the input of each inverter is provided with a pull-up transistor, as shown. It consists of a PNP transistor connected as a current source, whose current biases its associated inverter transistor into conduction unless otherwise diverted out of the input terminal.

The reasoning behind the transfer of the pull-up element from outputs to input is that this saves the power which would otherwise be wasted in pulling up unused outputs. By having the pull-up element at all inverter inputs, bias current is only drawn where it is actually needed; unused outputs are simply left unconnected, and draw no current.

The actual logic is performed with MTL inverters by connecting together outputs from a number of inverters to the input of another, using the technique known as "wired logic" or "dot logic". This was developed with earlier types of logic, as designers found that in certain situations they could achieve logic functions such as AND and OR merely by connecting the outputs of gates together.

The idea is simpler than it may sound, as Fig. 5(b) shows. If outputs from each of the two MTL inverters are connected together, the junction will be taken down to the low voltage level if either of the inverter inputs goes high. In other words, the simple connection of the two outputs produces a potental "NOR gate", if we think in terms of the high voltage level corresponding to logic true (1). All that is needed to achieve the NOR function is the pull-up action, which will be provided as soon as we connect the junction to the input of another inverter.



(a) BASIC INVERTER

(b) "NOR GATE" CONFIGURATION

(c) "AND GATE" CONFIGURATION

FIG. 5 : INTEGRATED INJECTION LOGIC (I^2L) OR MERGED-TRANSISTOR LOGIC (MTL)

Fig. 5(c) shows how a 2-input AND function may be realised using MTL elements. Here outputs from two inverters are fed to two further inverters, and outputs from each of these are again tied together. This time a "wired-AND" function is produced, however, because it will be potentially able to rise to the high voltage level only when both of the original inputs are also at high level. This corresponds to the AND function if the high voltage level is regarded as logic true (1).

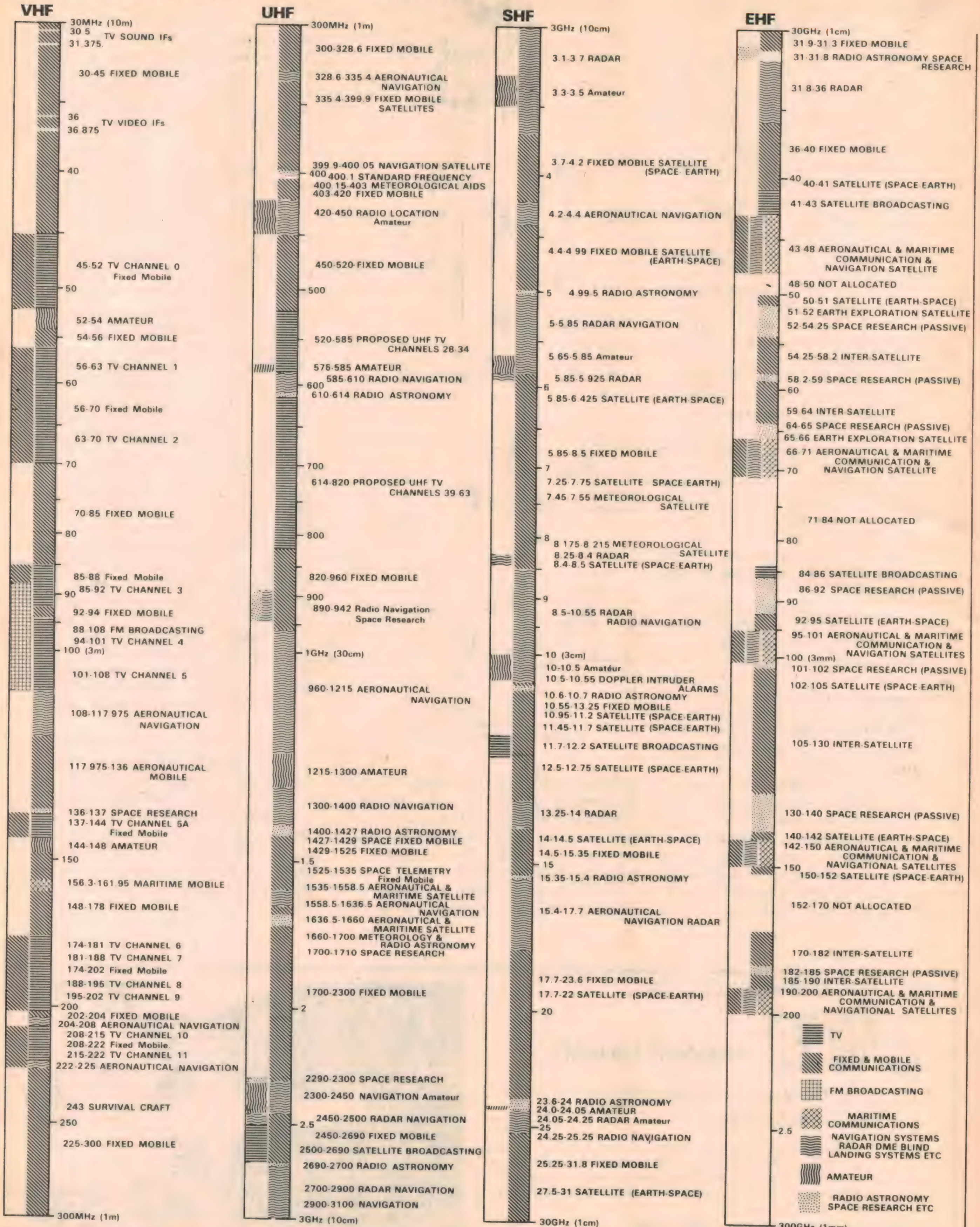
Note that with this configuration, there would be nothing to stop us from using the inverted inputs available at the outputs of the first inverters, as well as the AND output. It is this "multiple function" capability of MTL which makes it particularly well suited for large-scale integration of complete logic systems.

Another feature which makes MTL ideal for LSI devices is that it involves very few IC fabrication steps — even fewer than for CMOS. This is because the PNP transistor current sources are actually "lateral" transistors, formed in the silicon IC chip simply by placing the base diffusion "island" of the NPN inverter transistor near a common P-type region "busline" connected to the positive supply. An MTL inverter is thus little more than a single NPN transistor structure, and is inherently both small and self-isolating.

A further significant feature of MTL is that its power dissipation for a given speed is even lower than CMOS. In fact MTL has been shown to have the lowest theoretical speed-power product of any logic technology yet developed, with a figure of .001 picojoules compared with about 0.1pJ for CMOS and about 100pJ for standard TTL. Like CMOS, MTL will also work at low voltages — down to about 1V.

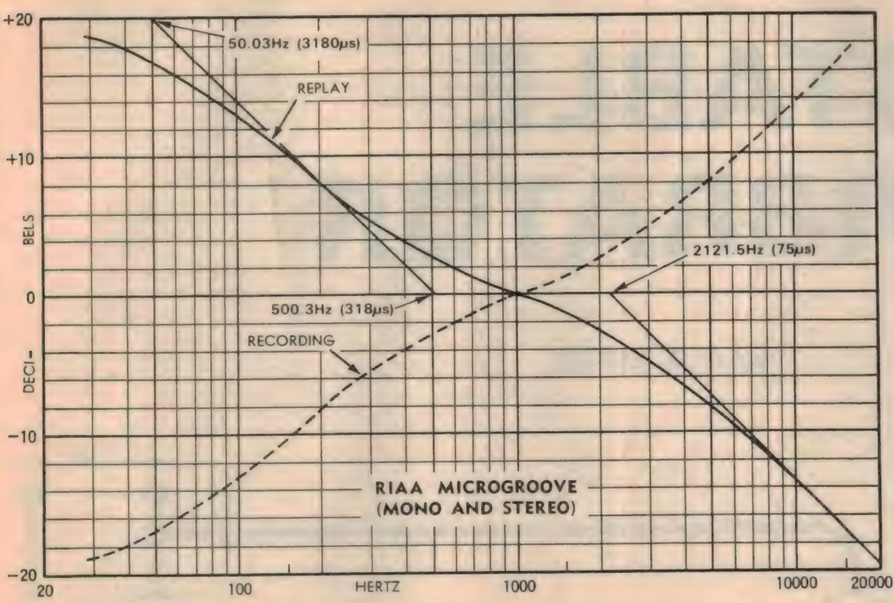
In this chapter we have looked at the various "families" of logic devices which have evolved to date, and the technology on which they are based. I hope this helps you visualise the direct electronic implementation of the basic logic functions introduced in chapter 2, and thus gives you a solid foundation on which to build as we go further into logic system design.

FREQUENCY SPECTRUM



Services shown in small letters are secondary services. They must not cause interference to the primary service, and must tolerate any interference from the primary service. "Passive" segments: All emissions prohibited. Passive (receiving) devices only allowed.

DISC RECORDS—NEW & OLD



MODERN MONO/STEREO/QUAD

Nominal speed (rpm)	33⅓
Nominal diameter (in)	12
Outer recording diam (in)	11.52
Inner recording diam (in)	4.75
Centre hole diam (in)	0.285
Average pitch (grooves/in)	300
Stylus tip radius, normal (in)	0.0007
Stylus tip radius, min (in)	0.0005
Stylus, bi-radial, average	.0008 x .0003

MONO MICROGROOVE

As for 12 in stereo records above, except for stylus details. Most can be played with normal conical or bi-radial stylus, as for stereo but older pressings may give cleaner sound with a stylus of 0.001 in (1.0 mil) radius.

10 in MICROGROOVE

Nominal diameter (in)	10
Outer recording diam (in)	9.52

Other details as for stereo or mono above. Now virtually an obsolete format.

45rpm MICROGROOVE

Nominal speed (rpm)	45
Nominal diameter (in)	7
Outer recording diam (in)	6.625
Inner recording diam (in)	3.75
Centre hole diam (in)	1.5 or 0.285

Other details as for mono or stereo above.

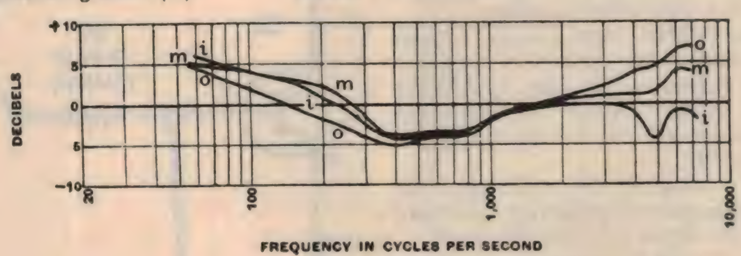
COARSE GROOVE MONO

Nominal speed (rpm)	*78
Nominal diam (in)	12 or 10
Outer record diam (in)	11.52 or 9.52
Inner record diam (in)	3.75
Centre hole diam (in)	0.285
Average pitch (grooves/in)	110
Normal stylus tip radius (in)	*0.0025

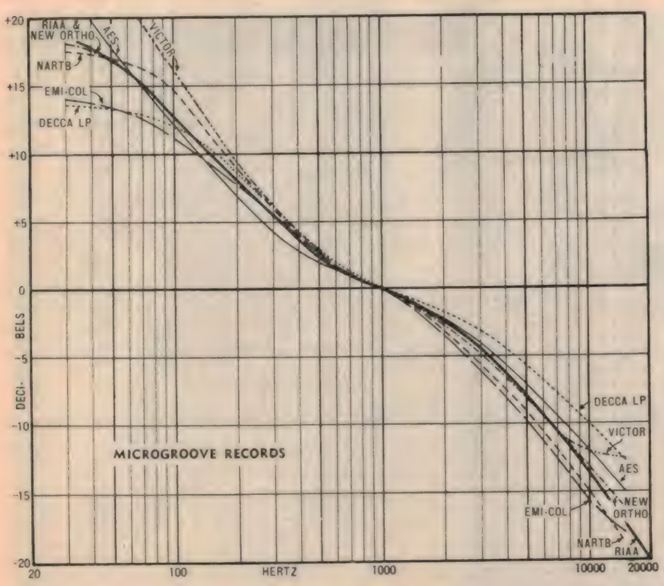
*Actual figure for some older discs varied from this by up to 2 rpm.

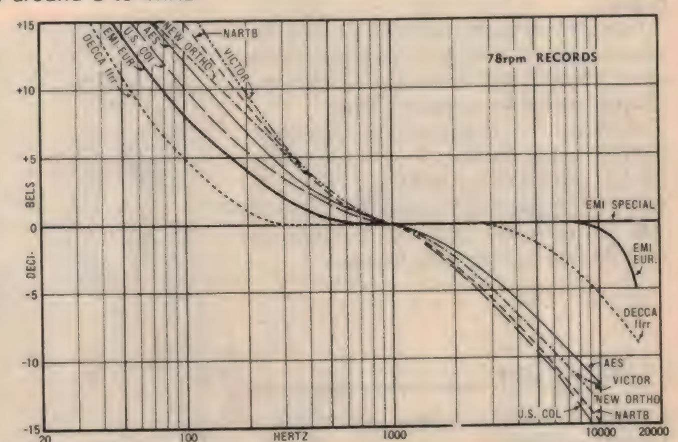
Some older discs played better with a styli up to 0.0035 in radius. Many late 78 rpm discs could be used to advantage with 0.002 styli.

Steel and thorn needles wore to fit the groove. Radiused, jewelled styli (right) on the walls. Angle of stylus taper is 40-50 degrees; groove angle about 90 degrees.



Curves by Buchmann and Meyer (1931) indicate the frequency distribution of noise in 78rpm discs of the era, for outer, middle and inner grooves. It tended to interact with available pickups to produce a prominent noise peak at the natural resonance of the system—usually around 3 to 4kHz.





At the top left are the standard RIAA record and playback curves used for modern stereo discs. The same playback curve is repeated at left (solid) and compared with curves for early mono microgroove discs. For vintage record enthusiasts, playback characteristics of various 78rpm discs is shown above.

THE BISTABLE MULTIVIBRATOR

by A. J. LOWE

One of the commonest circuits in electronics is the bistable multivibrator—and that's what this month's Teach Yourself Board aims to demonstrate. The layout of the board and the circuit are as shown in the photograph and the diagram.

Construction is straightforward, but care must be taken to prevent the crossed wires in the centre of the model from touching one another. As in earlier models the switches are simply strips of springy brass soldered to a nail at one end and set to close a circuit when pressed on to a nail at the free end.

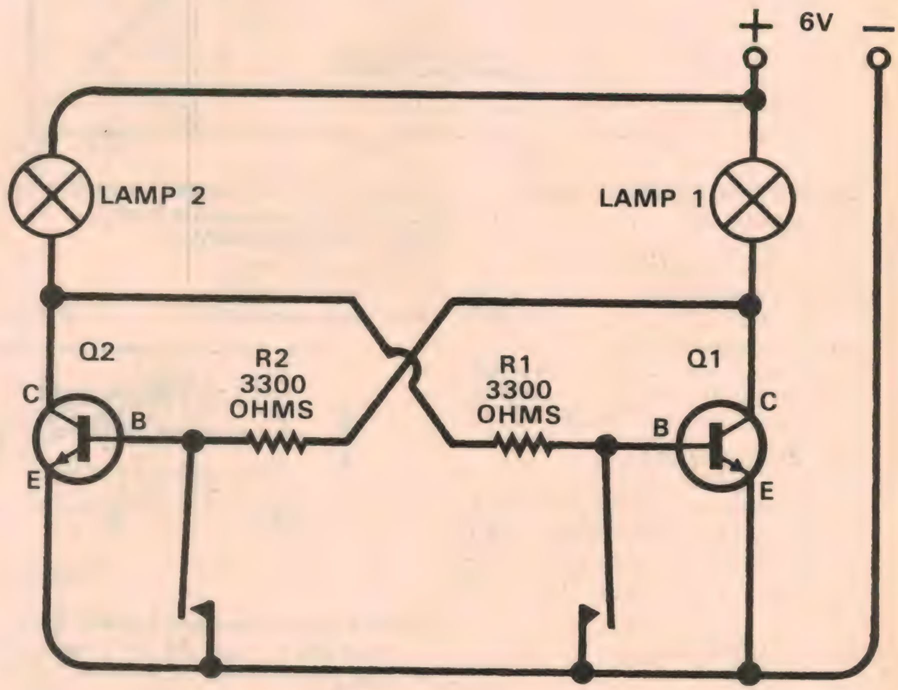
Resistors in the base circuits, R1 and R2, should be selected on test to ensure that the transistors saturate. The higher the gain of the transistor the higher the base resistor can be for any particular load current.

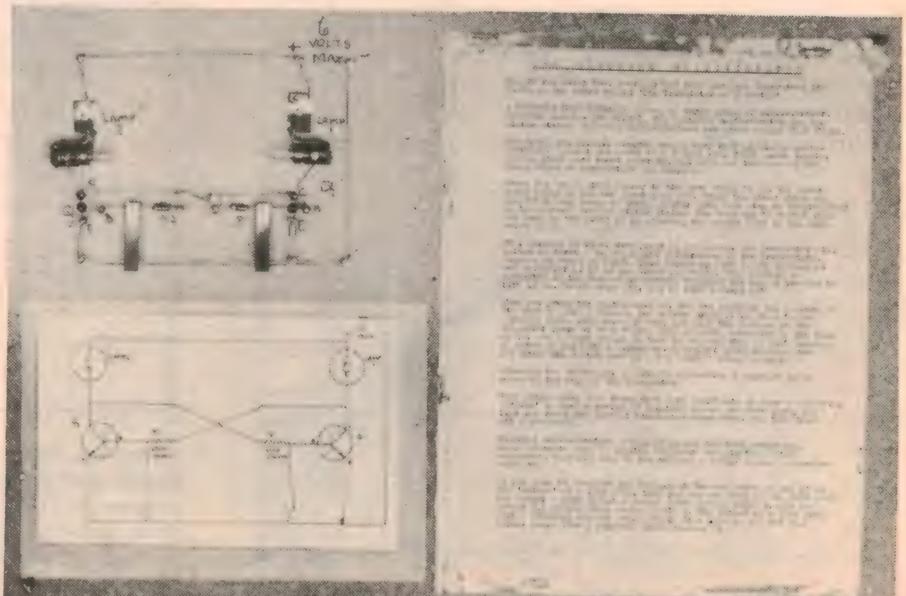
After completing the exercise on the opposite page, try connecting this board to the "Transistor as a Switch" board.

Connect both boards to the same battery. Connect the Q1 collector on the bistable board to the left hand end of the resistor R on the "Transistor as a Switch" board. (Do NOT press the switch on this board.)

Press the bistable switches. Note that when lamp 1 is alight the light on the other board is off. The output of the bistable controls the separate lamp.

Next try the "Unijunction Transistor" board. Simply connect the + terminal on the UJT board to the collector of Q1 and join the negative rails together. You can now control the UJT by pressing the switches on the bistable board.





PARTS LIST

2 resistors 3300 ohms or as selected
2 lamp holders
2 lamps 6 volts 0.1 amp (bicycle tail lamp type)
2 transistors BC 209 (National) or similar npn type
1 6 volt battery
Nails, wire, brass.

HOW THE BISTABLE WORKS

Before you study this board please make sure you understand the facts on the board called "The Transistor As A Switch".

A BISTABLE MULTIVIBRATOR is one of the three types of multivibrator. Bistable means—TWO STABLE. The bistable multivibrator has two stable states. Bistable multivibrators are sometimes called FLIP FLOPS.

The model and circuit diagram show a very basic bistable multivibrator. Connect the model to a 6 volt (NOT MORE) power supply, taking great care about polarity. You will see that one of the lamps comes on immediately and stays on.

Press the brass strip nearer to the lamp which is on. The other lamp comes on and the first lamp goes off. Press the other strip and the first lamp comes on again. Either lamp will stay on indefinitely, so the circuit has two stable states. The only way to switch from one lamp to the other is by pressing the switch near to the lamp which is on.

What happens is this: When power is connected, one transistor will switch on first—due to slight differences in the transistors. Suppose Q1 comes on first. This lights up LAMP1. The voltage at the collector of Q1 is now about 0.2 volt. This voltage is connected to the base of Q2 through resistor R2, and is too low to turn Q2 on. So Q2 stays off, and so LAMP 2 stays off.

When you press the switch near Q1, you are reducing the voltage on its base to zero—because the switch connects the base to the negative rail. This turns Q1 off, and then the voltage at its collector jumps to 6 volts. This is still connected to the base of Q2, and is high enough to turn Q2 on. And this is what happens. Q2 comes on and LAMP 2 lights up. A similar thing happens when you press the switch near Q2—and LAMP 1 comes on again. Pressing the switch is, in effect, connecting a negative going pulse to the base of the transistor.

More complicated flip flops have more components to make a "steering circuit" so that a series of negative pulses can come along one line and reach the correct transistor every time, and turn them off alternately.

Bistable multivibrators—flip flops—are one of the most common and basic elements used in digital computers and digital control equipment. They are used by the million—mostly inside integrated circuits.

If you like to consider the voltage at the collector of say Q1 as the "output" of a flip flop, then you can see that it can have only two values—high (about 6 volts) often called LOGIC 1, and low (about 0.2 volts) often called LOGIC 0. The output of a flip flop with a steering circuit would change from high to low and vice versa, every time a negative pulse reached it.

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Reviewed by Julian Russell

Wagner—The Mastersingers of Nuremburg

WAGNER — The Mastersingers of Nuremburg. Complete Opera. Karl Riddersbusch (Sachs); Hans Sotin (Pogner); Klaus Hirte (Beckmesser); Jean Cox (Walther); Frieder Stricker (David); Hannelore Bode (Eva) and others with the Chorus and Orchestra of the Bayreuth Festival conducted by Silvio Varviso. Recorded live at Bayreuth. Philips Stereo 6747 167. (5 Discs).

The Mastersingers means different things to many different people. To some it is a comic opera, originally designed to bring in some much needed cash to keep Wagner in funds while he was working on mightier projects. Wagner had intended it to be a send up of both the Minnesingers he used in Tannhauser and the historical Mastersingers of some hundreds of years later. But Wagner didn't start on the work for some 20 years after its conception and during that time he had so matured musically and dramatically, that he felt it necessary to expand the work to its present proportions.

Others see it — as did Hitler — simply as a glorification of "our holy German art" and the noble sentiments of the German people, with emphasis on the bourgoisie. But not many, even those who revere it, see it in the subtleties pointed out by Gottfried Wagner (the composer's great grandson?) in his brief but illuminating notes that accompany the distinguished set under review. For, despite some very minor shortcomings, this is a very distinguished recording indeed. Gottfried point out that no character is always quite so simple as he or she seems at first acquaintance; that a character might be singing one thing while thinking something quite different. And if you are unaware of these complexities you will be vastly entertained in confirming them when you play the work.

Wagner, a master dissembler himself, was no slouch when it came to painting people with similar characteristics. He gives us a city full of people unsure of themselves and the outcome of their thoughts and actions, or even in the spirit of the times in which they lived.

There is one thing I must make clear right at the start. Despite his name—Silvio Varviso—here is no Italian trained in the traditions of Italian opera conducting a work as echt-German as The Mastersingers. Quite the contrary. Varviso was born in Zurich—a German speaking province of Switzerland, though it is true that the German spoken there differs essentially from that used in Germany—where he did his musical studies. All his life he has been associated with German music, in particular opera, which he has conducted in the chief music centres of the world. So you can set your mind at rest that you are not going to hear an Italianised version of the opera. His is a superb reading of this massive work, constructed on a treasure chest of exquisite details in its observations of the strength and weaknesses of human nature. His control of orchestra, vocal soloists and chorus is as firm as it is sensitive.

Another important recommendation. This recording was made live at a Bayreuth performance but produces very little distracting noises which intrude from stage movements. Techniques in this form of recording have improved out of all comparison since the first recording—Parsifal—made in this manner some years ago. Of course some extraneous noises are inevitable in recording a live performance. Thus you can hear furniture being moved on the stage by the apprentices during Act 1, and again their clod-hopping dancing in Act 3. But the audience are absolutely silent until they break into enthusiastic applause at the end of every act. There is no coughing, for to cough during a performance at Bayreuth is to invite strangulation at the hands of your neighbour. I have been there, so that I am speaking from experience.

As to the performance recorded here, it starts with an overture that is always solid but never ponderous. And there is no perceptible change of acoustic when the curtain rises without a break onto the church scene with the congregation singing a hymn. All through the opera the balance between chorus and orchestra and other singers is faultless and offers a true reproduction of the marvellous acoustics of the Festspielhaus that Wagner designed himself at Bayreuth. Many record buyers might find the names of many of the cast unfamiliar but all are good. Perhaps the best known will be Karl Riddersbusch who gives a noble performance of the cobbler-poet Hans Sachs. The part of course was written by the composer as he saw himself, leaving out all his warts and weaknesses that those who met him finally became aware of, usually to their discomfort and often pecuniary loss.

Riddersbusch's Sachs has his noble moments, and sees far into the musical future. But that doesn't prevent him having human shortcomings in the way of cunning and mischief.

Another superb portrait is Hans Sotin's Pogner, the rich goldsmith, bourgeois and proud of it, the kindly but stern father of Eva, the young heroine of the opera. Her lover, Walther (Jean Cox), has a fine tenor voice after some initial uncertainty at the beginning, and is above all, a youthful sounding swain without the Bayreuth "bark". He is alternatively ardent in his wooing, irritated beyond endurance by his treatment at the hands of his judges, the Mastersingers, and rhapsodic in his singing of the Prize Song.

Eva (Hannelore Bode) also has a refreshingly youthful sounding voice used expressively to characterise a girl, who despite her gentle obedient exterior knows just what she wants and how to set about getting it. Frieder Stricker's apprentice David enlivens his part so that his first act instructions of Walther in the Mastersingers' rules never become the bore they sometimes do. Stricker constantly entertains as well as instructs. Beckmesser (Klauss Hirte), too, is not the grotesque idiot he is sometimes made to appear but instead a man convinced of his own rectitude, however mistaken his ideas. He makes a splendid contrast to Pogner's Rembrandt-like portrait of a rich, fur-clad burgher and Sach's leather-aproned shoemaker.

Not a point is missed by Varviso in his interpretation of the ever changing score whether it is the pomp of the Mastersingers, the swooning beauty of the Midsummer Night's music, the malice of Beckmesser, the lovely lyric passage between Pogner and Eva and the true magnificence of the chorale "Wach Auf."

There have been other good recordings of The Mastersingers but for my book this is the best that has so far appeared. True it is not absolutely perfect. But then a really perfect performance of this grand work is well nigh impossible to achieve, even with all the resources of a studio performance, where unsatisfactory bars can be cut out and others substituted. And don't forget that this is a live performance and therefore an invitation for things to go wrong. But there are here so few, even in the great fugue at the end of Act 2, that to have seen and heard it must have been a wonderful experience.

RACHMANINOV—Piano Concerto No. 2 in C Minor. Variations on a Theme by Paganini. World Record Club Stereo C 00361 (0663-2).

Although this is not Dolbyised it was recorded in stereo. The sound is reasonably good with some almost negligible background noise. The balance between soloist and orchestra is mostly good but I would like to have heard a little more of the orchestra in the fortissimo tuttis in the second movement of the piano concerto. This composition is one of the most popular concertos in the current concert repertoire and much of it has been used for other purposes—the background music for the Noel Coward film Brief Encounter, for instance.

There are a few moments of discomfort in the engineering. In the second movement of the concerto the flute loses some of its characteristic timbre and the general tone coarsens. This I corrected for a while by switching on the Dolby control but soon reverted back to non-Dolby when the piano part became altogether too assertive at the expense of the orchestra. The playing of both soloist and orchestra is fine.

Both use very fast tempos in the Paganini Variations but the music is always under firm control by both. In this work and the concerto conductor and pianist use some very robust romantic treatment which, to my mind, is essential to a successful performance of either work. I also thought the balance between piano and orchestra consistently better than in the concerto though not up to the highest standards. Let's hope a Dolbyised version of the whole production might be issued some time in the future. The performances will warrant it. By the way, when Shostakovich Jnr. was out here last year, he told me that the correct Russian pronunciation of Rachmaninov's name is "Rachmaneenov" and that he, Shostakovich, pronounced his name with the accent on the second syllable.

★ ★ ★

LAURIS ELMS (contralto) with GEOFFREY PARSONS (piano) in a recital of songs by Schubert, Liszt and Duparc. World Record Club Dolbyised cassette C 02224.

Here is an Australian recording of world class, engineered by the Australian Broadcasting Commission for release to the members of the World Record Club in Australia. I have only one fault to find with the whole production—no texts accompany the songs, though admittedly some are well enough known by the average record buyer or concert-goer to need none. Ms Elms voice is a rich contralto, always expressive, always smoothly produced throughout its extremely wide range.

The makers of this cassette have no reason to feel timid about its release in any of the recognised music centres abroad. When necessary, Ms Elms can hold a tranquil sounding note for a surprising length of time. The Lorelei included in the recital is not the familiar Schumann setting of Heine's poem but another, less familiar one by Liszt. The accompanist is Geoffrey Parsons, one of the world's best and, as a rule, I admire vastly everything he does. I in no way subscribe to the theory that an accompanist should be self-effacing and Parsons is never guilty of this practice. But in the Lorelei I do think that for once he overplays the dramatic piano part here and there. But this is the only slight blemish on an otherwise perfect combination of singer and pianist.

Ms Elms' diction is always exemplary even when one concedes that her French accent is not always that of the 16th arrondissement. And it is unusual to find non-French singers able to cope as she does with the sometimes cruelly long French legatos. Importantly Ms Elms, despite the unquestionable beauty of her lower register—and all the others for that matter—never indulges in the contralto hoot so popular, alas, with so many English oratorio singers. Some listeners might object to an occasional portamento up to a high note though others will maintain just as vigourously that it is quite permissible wherever she uses it. I find it incredible that Ms Elms should be represented in the English Gramaphone Catalogue only by a smallish part in Britten's Pete Grimes. I think this is depriving a large record buying public of a most enjoyable experience. Here is singing to delight connoisseurs and ordinary music lovers alike and Australia may well feel proud of the two artists on this cassette. By the way I also have discs recorded by Ms Elms that I shall be reviewing in later issues.

Mozart—Complete Wind Music: recommended

MOZART—Complete Wind Music. Diviertmentos, Serenades and so on played by the London Wind Soloists conducted by Jack Brymer. World Record Club Stereo Nos. 4771-2-3-4-5. (Five boxed Discs.)

Although this set was first recorded some 13 years ago it is still very worth while acquiring, especially at its club price. It was hailed as an example of a very high standard of engineering in its day and it remains excellent, even by the highest of modern standards. Nowadays there are several competing wind groups but none that I have heard excel this English combination. There is no showing off, no spotlighting of soloists. All, under Jack Brymer, just play the music for what it's worth. All five discs are distinguished by the same highly faithful recording of the sound. And the players' skill is never in doubt during a single item. When one remembers that most of these works were written for performance in the open air and that wind instruments can have an ear-piercing quality, much ingenuity was displayed by the recording engineer in the matter of restricting the dynamic range to within range of comfortable listening in an average sized music room.

As to style, this is the kind of Mozart I was brought up on and find it flawless here. And I must make special mention of the way the timbres of the various instruments are superbly blended. To my ear Brymer chooses just the right tempo for each item. Many of these pieces are masterpieces, others perhaps not quite so exalted. But to have them all in the one set to play at will—I cannot imagine anyone settling down to listen to all at one sitting—is an unqualified blessing. Although the title "complete wind music" is a little misleading when one remembers divertimenti of doubtful origin which have been omitted, a couple of cavalry band items also omitted, and a few other negligible pot-pourris, you will find in this collection all the music of importance that Mozart wrote for wind instruments alone. And among them you will find much to enchant you, including some that the most enthusiastic of Mozartians will be hearing for the first time. Highly recommended.

Lighter Side

Reviews of other recordings

Devotional Records

THE NEW COVENANT by John Fisher. Stereo, Light LS-5658-LP. (From Sacred Productions Aust., 181 Clarence St, Sydney and other capitals).

Christian musicals seem to be making their appearance as regularly as their non-devotional prototypes and there is no doubt that they are providing church musical groups with an incentive to sharpen their talents and to present the Gospel message in a new way.

This one is endorsed "A Teaching Musical" and, as such, contains a fair amount of spoken commentary between the numbers. In a sense, it might be regarded as a sermon in music, with the theme based on the need to live a genuine Christian life rather than merely to act the role.

The track titles are as follow: Let It Be Free—What Has Gone Wrong—Evangelical Veil Productions—Ways and Means – Alleluia – The Way Of Peace—I'm A Vessel—We All Get Hurt—We Have Died—Rest In Him—Alleluia (Reprise).

"Evangelical Veil Productions" is a bright, humourous number that is nevertheless the cornerstone of the musical. On the recording, at least, interest tends to sag a little after this number until things get going again on side 2, but this would not necessarily be the case with stage production. It's well worth a hearing, if you are on the look out for a new production or merely interested in Christian musicals. I gather that guitar and vocal scores would be available. (W.N.W.)

★ ★ ★

GENTLE AS MORNING. The Anita Kerr Singers. Stereo, Word WST-8646-LP. (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals).

Over many years, one has grown to accept the Anita Kerr Singers as an essential part of the Nashville scene, providing skilled backing for many featured artists. It comes as a surprise therefore, to learn that, for a considerable time, they operated from west coast USA; further, that Anita Kerr now lives with her husband and two daughters in Switzerland, with London as her prime recording base.

In this album, the first of a new series, she has teamed up with the Word organisation to produce records and choral books. Her multi-role in this one includes arranger, conductor, soloist and mix-down controller.

With a generous rhythm orchestra and chorus, this talented and attractive artist presents ten tuneful modern style devotional songs: Sunday Morning—I Believe Now—Gentle As The Morning—Sonshiny Day—Gentle Like You—Don't Play The Game—Walk His Way—Live Love—That's For Me—And I Believe Him.

Fully imported from USA, the sound is very smooth and pleasant with just one slight technical blemish: a tendency for the sibilants on solo voice to blast occasionally. But don't let that deter you if you would like to hear Anita Kerr and her singers "doing their own thing". (W.N.W.)

★ ★ ★

THIS COULD BE THE DAY. Mickey Holiday. Stereo. Singcord ZLP-897S. (From S. John Bacon Publishing Co, 12-13 Windsor Av, Mt Waverley, Vic 3149. $6.95)

Mickey Holiday is a new name to this reviewer but he is pictured on the jacket of this American pressing as a youngish vocalist who would have obvious appeal on the Gospel rally platform. His voice is a pleasant baritone and one's first impression is that this is to be a recording of popular Gospel songs with a faint C&W flavour. But the style, and particularly the backing arrangements become more obviously orchestral, with even a trumpet chorus for "King of Kings and Lord of Lords", reminiscent of the "Hallelujah Chorus", Other titles are: Praise The Lord—This Could Be The Day—Thank You Jesus—Believe It Like It Is—My Prayer—Wise Men Should Still Seek Him—All I Need—Heaven—Come, Come.

In typing the list I noted that eight of the ten titles are endorsed "Holiday/Singspiration"—apparently his own compositions, with Singspiration as the publishers. The technical quality is good and you can buy with confidence if the titles appeal. (W.N.W.)

Instrumental, Vocal and Humour

THE FLIGHT OF THE BUMBLE BEE. Attack On Limit. W&G QX quadraphonic WG-35/Q/5628.

The "Attack On Limit" part of the title is somewhat obscure but the jacket notes refer to the special "Master Sonic" cutting method used for this regular matrix recording, and to the use of electronically contrived sound to supplement the normal orchestral instruments. Either could account for the title.

But details aside, the album recorded in Tokyo by the Nippon Columbia Co Ltd has a very clean sound, easy on the ear, and featuring six well known neo-classical excerpts: The Flight Of The Bumble Bee (Rimsky-Korsakoff)—Zigeunerweisen (Pablo de Serasate)—Fantasie Impromptu (Chopin)—Turkish March (Mozart)—Hora Staccato (Dinicu)—Carnival Of Venice (Benedict).

Some may be turned off by the admixture of synthesiser type sounds but, here anyway, they are merged into the orchestra, rather than being highlighted in any particular way. And, while a quadraphonic system can spread the sound throughout the room, it still comes across very well in ordinary stereo. In short, the album has the potential to provide an interesting variation in either a popular or a classical collection, with the knowledge that you will certainly never have to apologise for its technical quality. (W.N.W.)

★ ★ ★

SPECTACULAR CHORUSES. The Philadelphia Orchestra under Eugene Ormandy with the Philadelphia Chorus, directed by Robert Page RCA Red Seal ARL 1-0580.

"Spectacular" is indeed the word for these high-powered performances of ten best known choruses with titles like: Land Of Hope And Glory—The Exodus Song—La Marseillaise—Battle Hymn Of The Republic—On Great Lone Hills (from Finlandia)—Meadow Lands—Hatikvah—Rule Britannia—Glory, Glory—The Star Spangled Banner.

Rule Britannia almost gets the 'Messiah' treatment but all in all, it is a record of excellent quality, ideal to stir one out of any lethargy. It shows what musical professionalism is all about when you hear a record like this. I would highly recommend it as a demo disc. (N.J.M.)

Reviews in this section are by Neville Williams (W.N.W.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.) and David Edwards (D.W.E.).

DONALD McINTYRE SINGS WAGNER. The New Zealand Symphony Orchestra, conducted by John Matheson. Stereo, Kiwi SLD-39. (From local record shops or direct from Crest Record Co, 122 Chapel St, St Kilda, Vic 3812.)

By chance, two snippets of conversation preceded my listening to this recording: "I thoroughly dislike operatic excerpts; the whole work or nothing"; and "I like Wagnerian opera in small helpings . . . a full opera is a bit too heavy!"

If you happen to share the second view, read on. This is an all New Zealand record, recorded in Wellington Town Hall with the N.Z. Symphony Orchestra; conductor for the occasion was John Matheson, born in Dunedin, but with a considerable background as an operatic conductor at Covent Garden and elsewhere. Soloist Donald McIntyre was born in Auckland and is described in the jacket notes as the World's leading Wagnerian bass baritone, with an impressive record in the musical centres of Europe. Recorded under the auspices of the Arts Council of New Zealand, the album itself won the country's award as the best cultural merit album, with a similar tribute to the special double-fold cover. One can well understand why.

The excerpt titles are: Der Fliegende Hollander: Dit Frist Is Um. Die Meistersinger: Was Duffet Dock Der Flieder (Act II) and Wahn! Wahn! Uberall Wahn (Act III). Lohengrin: Du Furchterliches Weib (Act II). Die Walkkure: Leb Wohl, Du Kuhnes (Act III).

To by hypercritical, the recording may lack somewhat in sparkle at the treble end, but it is smooth and quiet. In summary, if your interest lies in this direction, you should find this recording from across the Tasman a very satisfying purchase. (W.N.W.)

★ ★ ★

THE MAGIC OF VIENNA. June Bronhill, Peter Jeffs Eric Shilling; With the Gaiety Orchestra conducted by George Barker. Stereo, Astor SPLP-1450.

An unusual album, this; a program of Viennese style operetta, capably presented by the artists and orchestra listed above. It may be appropriate initially to list the excerpts and composers for your guidance: Werner March (Ziehrer)—I Must Behold Her ("The Conspirators", Schubert)—The Alligator and the Brahmin's Daughter ("The Beggar Student", Millocker)—I Gave My Heart ("Du Barry", Millocker) — Fragrance of May ("Count of Luxembourg", Lehar) — Pig Breeder's Song ("Gipsy Baron", J. Strauss Jr) — Polka Dance ("Count of Luxembourg") — Chambre Separee ("Opera Ball", Heuberger) — Fleet of Foot (J. Strauss Jr) — A Slap In The Face ("Beggar Student") — Roses In Tyrol ("Der Vogelhandler", Zeller) — Schonbrunner Waltz (Lanner) — Love Live For Ever ("Paganini", Lehar) — Rector and Director ("Der Vogelhandler") — Love And Age ("Count of Luxembourg").

As will be evident it is a generous program and the presentation is equally generous, with detailed notes on the music and the artists, together with pictures, inside a handsome double-fold jacket.

The sound from the smallish Viennese style orchestra is intimate rather than expansive but it is completely clean. If the program appeals, you'll enjoy the album. (W.N.W.)

★ ★ ★

THE JOLSON REVIEW, featuring Dai Francis. United Artists L 35562 Festival Release.

Any one who remembers the 'Black And White Minstrel Show' on TV a few years back will recognise the format and quite a few of the voices, particularly Dai Francis.

Including the medleys, there are at least two dozen titles to enjoy, some of these are: Shaking The Blues Away — Alabama Jubilee —Rock A Bye Your Baby — Sonny Boy — Anniversary Song — He's Got The Whole World In His Hands — When The Saints Go Marching In.

The whole record has a bright and bouncy sound to clear away the blues. (N.J.M.)

★ ★ ★

DES O'CONNOR, WITH FEELINGS. Astor Release SPLP 1453

I must admit to being a Des O'Connor fan, particularly for his TV shows, and this record only reinforces my enthusiasm

The twelve titles are: Feelings — The Way We Were — Twelfth Of Never — I Won't Last A Day Without You — Misty — Spanish Eyes — Empty Chairs — Make It With You — Love Me Tender — Welcome To My World — You Were Meant For Me — So Close.

The musical backing was organised by Colin Keyes and the record would make an excellent addition to your ballad collection. (N.J.M.)

★ ★ ★

JAMIE REDFERN'S GOLDEN HITS. Jamie Redfern. Festival L 35724.

Jamie Redfern is a product of "Young Talent Time", and a protege of Liberace. With credentials like these, he shouldn't need much introduction, especially since this year he was crowned "King Of Pop". It should be sufficient merely to list the songs included on the record:

When You Wish Upon A Star — I Thank You — Over The Rainbow — I Believe — Little White Cloud That Cried — Rainbow On The River — Once Every Year — Venus — Jenny — You'll Never Walk Alone — Tie A Yellow Ribbon — Hitch A Ride On A Smile — We'll Meet Again.

Technical quality is quite good, so if you're a fan, go ahead and purchase. (D.W.E.)

LIGHTER SIDE—continued

LOWREY SHOWCASE. Ray Thornley. Stereo, Troubadour TSE-041. (From local record shops or direct from Unison Productions, 118 Terry St, Rozelle)

I gather that this album has been around for some time but it has proved to be a consistent seller, because people who happen to hear it insist on buying a copy of their own. The reason is clear enough: the sound is gentle, rhythmic, varied and always very easy on the ear—ideal for relaxation or a candle-light dinner, particularly the latter.

Ray Thornley is a young Sydney organist who first took up the instrument as a diversion from University studies. Here, in true professional style, he plays a program of thirteen numbers:

Rhythm Of Life — Fiddler On The Roof — Misty — Serenata — Spanish Harlem — Scarlet Ribbons — El Cumbanchero — And I Love You So — Michelle — The Twelfth Of Never — Under The Double Eagle — My Cup Runneth Over — Yakkety Sax.

The recording is clean and quiet and the range of voices sufficient to quicken the interest of any popular organ enthusiast. (W.N.W.)

★ ★ ★

THANK YOU BABY. The Stylistics. Avco stereo L 35551.

The Stylistics are pleasant a pleasant hybrid of the Temptations and the Four Tops. Their strong point is harmony while their weak point is lack of the services of a good songwriter. Most of the songs on this album are innocuous and forgetable. They deserve better. Record quality ranges from good to fair.

Ten tracks are featured: Thank You Baby — Can't Give You Anything (But My Love) — What Goes Around Comes Around — I'd Rather Be Hurt By You (Than Be Loved By Somebody Else) — Disco Baby — Tears And Souvenirs — A Honky Tonk Cafe — I'm Gonna Win — Stay — Sing Baby Sing. (L.D.S.)

CLASSICAL ORGAN: "Pride of place". . .

ORGELMUSIK IN DER WIESKIRCHE. Franz Lorch. Pelca, stereo PSR 40 588. (From local record shops or direct from Crest Record Co, 122 Chapel St, St Kilda Vic 3182.)

I might have been able to pass on a great deal more information about this fully imported German album, had I been able to read the language. For those who can do so, the jacket contains detailed notes about the music, the church, the organ, and the player. I gather, however, that the church is in "Sound Of Music" country in Bavaria, dating back to about 1730. Outside the design is conservative but, inside, it is the most ornate and highly decorated church I have ever seen.

The organ presumably dates back to the same era, though presumably reconditioned and modified much more recently. Whatever the details, it is an outstanding example of the European organ builder's art, with pipes at every possible footage from 16' to ½', and tone colours from round flute to near-percussive, from chiff-rich to Krummhorn. It is one of the brightest, cleanest organ sounds you are ever likely to hear and the recording quality merits the same description. In fact, when I played it in our laboratory listening room, at least two other members of the staff decided on the spot to buy a copy for themselves.

The music, dating back also to the eighteenth century includes: J. S. Bach: Fantasie G-Dur BWV 572; Triosonate Nr C-Dur BWV 529. D. Buxtehude: Praludium und Fuge F-Dur; J. Pachelbel Partita, Christus, der ist mein Leben. V. Lubeck: Praludium und Fuge E-Dur.

The organist Franz Lorch is a musician of high repute and gives a performance which is virtually flawless, even if slightly clinical.

But one thing is certain: if you are interested in the classical organ sound, this album is likely to take pride of place in your record collection. Recommended. (W.N.W.)

THE BEST OF DUKE ELLINGTON. Jazz of World War II. Joker mono SM 3134.

This album is one of a complete series entitled "History of Jazz" produced on the Joker label and originating from Milan, Italy. The particular album would appear to have been remastered from original 78 rpm masters. As such, the quality is reasonably clean, even if greatly limited in bandwidth.

Any keen collector would consider this album of Duke Ellington performances worthwhile. In many ways I find it much more satisfying than his later performances, particularly those in his latter years.

Tracks featured are: Creole Love Call — It Don't Mean A Thing — Harlem Air-Shaft — The Kissing Bug — Prelude To A Kiss — Ring Them Bells — Diminuendo in Blue & Crescendo In Blue — In The Shade Of The Old Apple Tree — Frankie & Johnny. (L.D.S.)

Joker records are distributed by the Crest Record Company, 122 Chapel St, St Kilda, Victoria. Postal enquiries should be directed to P.O. Box 270, St Kilda, 3182.

★ ★ ★

SONGS FOR LIVIN' & LOVIN'. Heather McKean. Festival stereo L 35565.

Heather McKean sounds like Australia's answer to Loretta Lynn. I think it is a pity that so many C & W artists are content to mimic their peers rather than try to develop a style of their own. Heather McKean certainly has personality but would do better not to exaggerate her assumed nasal twang. Instrumental arrangements are typical of C & W and recording quality is good.

Track titles are: I Can Feel Love — Afraid To Live And Afraid Of Dying — Crack Of Dawn — I'll Always Be Your Woman — Just A Little Place To Cry — The Best Years Of My Life — Right Or Wrong — Hello Out There — Put It Off Until Tomorrow — All I Need Is You — Portable Blackmail — I'd Do As Much For You. (L.D.S.)

★ ★ ★

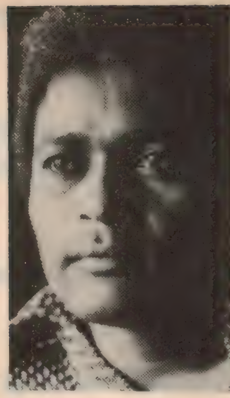
HARPS ON MY MIND. Hank Meadows. RCA Victor stereo VPL1-4014.

I must admit to being rather partial to harps and so it was with pleasant anticipation that I put this disc on to play. And I must concede that the instrumental work is very good and easy on the ear. But four tracks are spoilt when Hank Meadows is moved to sing. He moves me too but in a different way. He has a range of all of half an octave, sings mostly flat and often horribly off key.

If you don't mind skipping those tracks which have been spoilt, it is still very pleasant listening. Sound quality of the album which was recorded in Australia is excellent.

Eleven tracks are featured: Venus — Dirty Old Man — Donna's Samba — Amazing Grace — Blue To Green — Rain — Children's Games — Killing Me Softly With His Song — Rainy Days And Mondays — Morning Has Broken — Venezuela. (L.D.S.)

CHARLEY. Charley Pride. RCA Victor APL1-1038.



Charley Pride has eleven Gold Records, as well as numerous awards and this, his twenty-third album, certainly has the professionalism that one would expect. His deep, country voice wends it's way through ten ballads in a very pleasant way.

While none of the tracks had any immediate and overwhelming appeal, I did enjoy listening to them. I have a feeling that this album will be a "grower"; its appeal will build up with playing.

As is usual with this label, record quality is quite good. As a bonus, a large colour poster is included with the record. (D.W.E.)

★ ★ ★

THIS IS ME. Caterina Valente. Astor stereo SPLP 1446.

Even when sleeve notes are brief they can over-praise. On this album they state that Caterina Valente's talent is vast and phenomenal. Most people are aware that Valente can sing in many languages. Well, my first thought on hearing this album was that mediocrity knows no language bounds.

Recorded live, the album indicates that, at best, Caterina Valente is a reasonably talented club singer; at worst, a vastly over-rated performer. Two tracks represent the nadir of her performance: "Dominique" which she lah-lahs through with a drunken Italian named Silvio Francesco and "Mother Gooseova" which is every bit as intellectually insulting as can be imagined. Other points of irritation are Valente's woefully overdrawn phrases and the brassiest of club orchestras.

Those still interested because of their misplaced jingoism will no doubt be unfazed by the comment that recording quality is poor on some tracks and run-of-the-mill elsewhere. My lack of enthusiasm prevents me from listing the track titles. (L.D.S.)

★ ★ ★

REMEMBER DIANA. Paul Anka. RCA Gold Seal ANL1-0896.

A listen to this re-issued album of Paul Anka has confirmed what I remembered of him and his songs: A mediocre singer with the most trivial of songs. Still, it was innocuous I suppose. But why revive it? It sounds even more trite now than it did fifteen or so years ago.

The ten forgettable tracks are: Diana — Love Me Warm And Tender — Put Your Head On My Shoulder — Puppy Love — Eso Beso — Remember Diana — You Are My Destiny — In The Still Of The Night — Love Makes The World Go 'Round — A Steel Guitar And A Glass Of Wine. (L.D.S.)

★ ★ ★

A HOLIDAY IN GREECE. Manos Tacticos & his Bouzoukis Astor Golden Hour GH 591.

If you have a liking for music in the Greek style, this record would surely be your bag. With twenty-one titles to pick from (the only ones I can recognise are 'Never On A Sunday' and 'Zorba', the rest being in Greek) and one hour's playing time, you certainly get your money's worth. The quality is good but the level is lower than usual, to avoid problems with the extended playing time. (N.J.M.)

STEAM TRAINS: Kiwi style

A POWER OF STEAM. Historic sounds of locomotives in the North Island of N.Z. Mono, Kiwi LC-48. (From Crest Record Co, 122 Chapel St, St Kilda. Vic 3182.)

Travelling just north of Wellington, a year or so back, I suddenly spotted on the tracks nearby a compact but impressive looking steam loco, surrounded by a crowd of enthusiasts—typical of steam enthusiasts the world over.

And just as typical is this recording, which I would infer from the notes to be the fourth such recording in the Kiwi catalog. Side 1 is devoted to the Ka 945 and 955 express locos, recorded passing the microphone, from a pacing vehicle, and from within the train itself. On side 2 is featured Bb 144, banking engine Ka 943 assisted by a Da 1461 diesel (treason surely!) and another Ka class (943).

From this side of the Tasman, one can only rely on the jacket notes for some idea of the locos and the locale but the sound will still be music to the ears of steam enthusiasts—even though rather sad music recorded in the 1965/6 era as the steam locos were being phased out of everyday service.

Technically the sound is a trifle lacking in top-end "bite" but it is quite clean, well up to the average enthusiast mono recording. (W.N.W.)

New Products

CL8963/H Doppler Alarm from ED & S

Doppler burglar alarms (sometimes called "radar") are a novel way of protecting property. An alarm of this type, specifically intended for use in the home, was recently submitted to us by Electronic Developments & Service Pty Ltd.

This alarm, designated type CL8963/H, is based on the Philips doppler module which we featured in the May 1975 issue. Actually, we presented the type CL8960, which only differs from the CL8963 in operating frequency.

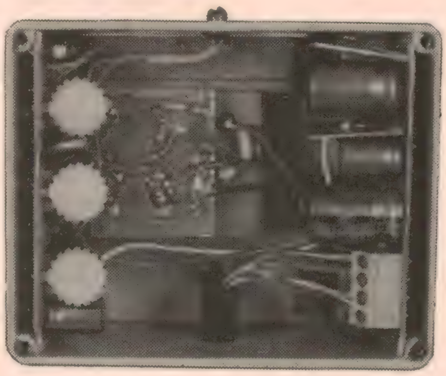
The CL8963 is pre-set to 10.525GHz, the frequency approved by the Postal and Telecommunications Dept for doppler alarms. No licence is required for alarms operating on the approved frequency.

As sold, the alarm consists of a single die-cast box containing the doppler module, power supply, audio oscillator and wobbulator on three fibreglass PCB's. A horn speaker and power supply completes the set-up.

The doppler module is mounted rigidly on one side of the box, with a cut-out for the microwave beam. The opening is covered by a thin piece of plastic. This, together with the plastic coating on the box itself, makes the unit impervious to moisture. The plastic coating is available in 16 colours.

Immediately above the cut-out is mounted a single LED, which glows whenever movement is detected. Apparently this is included so adjustments to sensitivity, etc, can be made with the speaker turned off (via a switch).

There are three preset pots mounted just inside the lid. These control, in turn, sensitivity, alarm "on-time" and alarm delay. The first two are quite straightforward—the sensitivity is variable from 2 to 30 metres (more about this in a moment) while the alarm "on-time" increases the time the alarm sounds after movement stops.



The three PCB's, doppler module and controls are shown in this internal shot. The diecast box in which they are mounted measures 120 x 95 x 57mm.

This is quite useful. The alarm can be made to sound only while movement is actually occurring, or it can be extended up to fifty seconds. This we confirmed. A longer alarm means that a thief will not be able to risk short, quick bursts of sound as he moves and stops.

What the alarm delay is for in this module is a bit of a mystery. It delays the alarm sound by up to half a second—but the LED lights instantly. As it was, we found most satisfactory operation with the alarm delay turned right off.

Such a delay would be useful in a more involved system where, for example, the motion was analysed before turning on the alarm. This facility is provided in some alarm systems to avoid false triggering caused by small animals, birds, paper, etc. However, it appears quite out of place in this simple alarm.

In the brief test conducted in our laboratory, we judged sensitivity quite adequate. It was relatively easy to set the sensitivity control to protect certain areas while leaving others "free". For example, a corridor could be protected while leaving an office behind it out of range.

A small problem, we found was that the initial switch-on delay was not as long as expected. The specifications state the unit is completely inactive for the minute after switch-on. This was not so with the sample we had. It gave a small "burst" at switch-on, followed by just twenty seconds of silence. After that, the alarm sounded. Hopefully, this was just a fault confined to our unit.

Although we can understand the alarm being supplied without a transformer, we cannot see a reason for not supplying the horn speaker as an integral part of the alarm. Not that there is any problem regarding supply (both items are listed on the parts list) but it would seem more sensible to supply the alarm system complete with speaker, not as a non-optional extra.

The reason for not supplying a transformer is clear: the alarm is suitable for a range of power sources, AC or DC—and many installers would like their options left open regarding mains power. It is often a good idea to have the alarm independent of the mains, so batteries or a transformer/rechargeable cell setup would be desirable. If required, ED & S have rechargeable batteries available.

Despite the minor points raised, we found the CL8963H Home Alarm performs well, and is suitable for guarding quite large areas. It would be well suited to the average home environment or, as is becoming more and more necessary, guarding a pool area.

Construction is neat and straightforward, and servicing should not be too difficult. If a unit does fail, ED & S will be able to service it. The CL8963/H carries a recommended price of $90.00 plus sales tax (15%) while the horn speakers are priced at $13.00 (+ ST). For further information contact ED & S at 27 Buckley St, Marrickville, NSW 2204. (R.P.T.)

Elega DR-196C headphones

Most stereo headphones are styled along conventional lines which may not appeal to the young and trendy. So here is the Elega DR-196C which has a blue and yellow denim headband.

Apart from the unconventional styling, the outstanding feature of the Elega DR-196C stereo headphones is their comfort. Because of their very light weight of only 170 grams and "open-aire" construction they can be worn for long periods. In fact they are so light it is possible to forget you are wearing them.

An adequate range of vertical adjustment is provided for the earpieces but they lack the ability to rotate horizontally, which is necessary if they are to conform closely to the user's ears. A two-metre connecting cord is provided and it is fitted with the conventional stereo jack plug. The earpieces are labelled Left and Right but the labelling should be a little larger for easy recognition.

Impedance of the phones is 100 ohms approximately and this combined with relatively high efficiency means that these Elega phones are well-matched to virtually any amplifier or tape deck. Maximum loudness level is also more than adequate although distortion rises rapidly at high levels.

There is little acoustic isolation from outside noises as a consequence of the "open-aire" construction and the same disadvantage applies in the opposite direction. Other people in the same room may be irritated by a tinny rendition of the program.

We assume that the transducers are dynamic but we did not have access to any manufacturer's data at the time of writing this review. The sound is beamed through an open-pore plastic foam to the listener's ears. This foam is black while the rest of the earpiece is padded with grey plastic foam. The foam padding is not removable for cleaning which we regard as a disadvantage as far as hygiene is concerned.

Nor is the denim headband material removable when it inevitably becomes soiled. This problem does not occur with conventional headphones.

Sound quality is quite pleasant though clearly not as extended in bandwidth as more expensive dynamic or electrostatic headphones. We also noted some midrange colouration which would tend to cause listener fatigue during prolonged listening sessions.

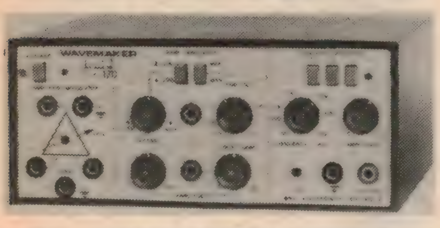
For those who regard comfort as all-important then the Elega DR-196C should certainly be considered, to determine if its performance satisfies your requirements. They can be obtained from all branches of Dick Smith Electronics.

NEW SUPPLIER FOR TRANSFORMERS & METALWORK

Star Delta Company Pty in conjunction with their subsidiary, Cowper Sheetmetal & Engineering Company announce that they can supply transformers, chokes and metalwork for projects described in "Electronics Australia".

Trade enquiries should be directed to Star Delta Company Pty Ltd, 8 East Street, Granville, NSW 2142.

Function/sweep generator



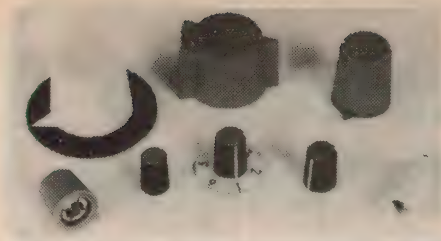
The model bwd 170 'Wavemaker' can operate as a self-contained function/sweep generator covering the 20Hz-50kHz range, or as a companion unit to almost any function generator. It provides a log or linear ramp to sweep VCOs, and amplitude modulation facilities.

Sine, square or triangle waves are switch selected and available at 5V p-p into 600 ohms or 10V p-p O/C. As a frequency doubler, input signal range is 0-5MHz. The unit will operate as a multiplier from DC to 1MHz with better than 10% linearity from DC to 100kHz.

Full details from BWD Electronics Pty Ltd, Miles St, Mulgrave, Vic 3170.

Collet knobs

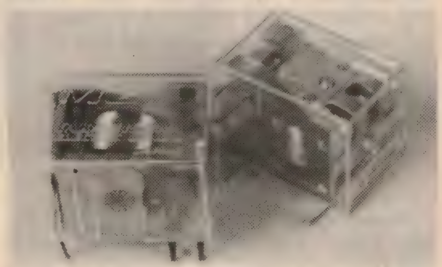
Pictured is a selection of collet knobs now available from Swan Electronics Pty Ltd (formerly McMurdo), Cnr Forster and Hardner Rds, Mt Waverly, Vic 3149.



The knobs come in sizes of 10, 11, 15, 21 and 29mm, the last three all designed to fit standard ¼-inch shafts. There are three basic knob colours (red, black and grey) and six pointer and cap colours.

Concentric fittings are available, as are figure dials and stators. Nut covers can be supplied for the smaller sizes.

Miniature relays



Available from Dick Smith Electronics, these two miniature relays are ideal for instruments, model control and applications where space is at a premium.

Designated types MZ5H and MZ12M, both units feature single pole double throw contacts rated at 24V DC 1A or 100V AC 0.5A. Operating voltages are 5V and 12V respectively, and coil resistances are 56 ohms and 320 ohms.

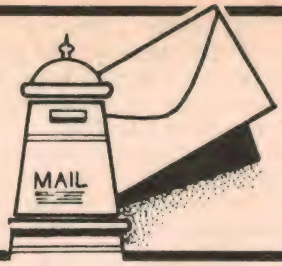
Case dimensions are a compact 15 x 11 x 10mm (L x W x H) and weight is just 3.5g. The units can be interfaced to TTL via a suitable buffer, and fit 0.1-inch matrix board.

E-Z-Hook range

Recently released in the E-Z range are the E-Z Mini-Hook and Mini-Hook XL combined with an easy-to-use pistol grip, and the E-Z range of Nailclips and Nailclip cable clamps (see Dec., 1975 EA).

All products in the E-Z range are now illustrated in a comprehensive 48-page catalog.

Further information from General Electronic Services Pty Ltd, 99 Alexander St, Crows Nest, NSW 2065.



Letters to the editor

Novice power limit

I refer to the article "Simple novice transmitter for the 3.5MHz amateur band" which appears on pages 44 to 49 of the January 1976 edition of your magazine.

In this article it is indicated that Novice Station licensees will be required to limit the direct current input power to the final stage of their transmitters to 10 watts. This is incorrect.

The power restrictions which apply to stations operated by Novice licensees are:

(a) All authorised emissions, except types A3A and A3J: 10 watts transmitter mean power output; and

(b) Type A3A or A3J emission: 30 watts transmitter peak envelope power output.

I hope this clarifies the situation.

W. McDonald,
for the Superintendent, NSW,
Regulatory & Licensing Section
Postal and Telecommunications Dept.

Limit Z-call tenure?

I was interested in your editorial comment in a recent issue of the magazine, on the matter of the issuing of a Novice Licence in the amateur radio service in Australia. As I see it, it is a matter of regret that whereas the Service already supports both a Full Licence (morse code at 12 WPM) and a Restricted Licence (no morse code), it would appear that there exists some special reason, of which I am unaware, why the Novice Licence (morse code at 5 WPM) should be reduced in tenure to 2 years. If the argument for reducing the tenure to 2 years is based on morse code, then surely the Restricted Licence or "Z-call" should likewise be of limited tenure? However if it is based on technical ability or lack thereof, then surely the Novice so desiring, could proceed to the Full Licence as he gains experience with simple equipment and of course one wonders why the Restricted Licence is required at all? Possibly it could be argued that all persons interested in amateur radio must be "encouraged" to acknowledge the Good Life and to become an amateur with a full licence, but then why penalise only the Novice? One suspects that each of these 3 licencees is a quite different type of person and that each could make a distinct contribution to Amateur radio within his own right and without penalty. If the reason for the Novice limitation is none of the foregoing then I am at a loss to understand the decision.

My final thought on the amateur licence intrigues me greatly—the person aspiring to become a "real" amateur will, if successful, in due course probably ignore morse code transmission and the development of technical skills (surely the essential part of being an amateur) to become the proud owner of an XYZ5000 little grey or black box which has not even been manufactured in Australia.

T. F. Pyke
Chatswood, NSW

COMMENT: I agree, the justification for the 2-year limit on tenure seems very obscure and illogical. Perhaps in view of the pace of technological progress, ALL amateur licences should have limited tenure, with renewal at any level by examination!

Examinations

I would draw your attention to past A.O.C.P. examination papers, which I have been reviewing in anticipation of the forthcoming(?) examinations. I have been preparing myself for this event over the past two years and have devoted an enormous amount of leisure time in devouring A.R.R.L., W.I.A. and similar recognised texts for an average of sixteen hours per week.

I am a professional man and I am no stranger to examinations, nor would I consider myself dull or retarded in any way. Can you imagine my horror when attempting past papers, not at the subject matter but in the time required to satisfactorily answer? Following recognised examination techniques, a prudent candidate would budget his time in accordance with the allocation of marks. As all questions carry equal marks the seven questions should require twenty minutes to answer.

The paper for February, 1974, contains the following twenty minute gem:

"1(a) Draw the circuit diagram of an amateur station transmitter suitable for operation in the 144-148MHz band. Explain briefly the theory of operation of each stage of the transmitter.

(b) Describe how you would tune the transmitter described in (a)."

Could anyone answer this satisfactorily in the allotted time?

I contacted the examination clerk at the Radio Branch for clarification—sure enough circuit means literally circuit, including all values. Why?—"We must maintain a very high standard." How many candidates are successful?—"On average about ten percent of candidates manage to pass!"

What is the purpose of the examination? To ascertain if a prospective amateur has a satisfactory knowledge of the subject matter thereby earning the right to be licenced, or is its purpose to restrict the number of users on the amateur bands?

Sir, I believe this matter and the matter of the two year tenure for novices can, collectively, only place the long term interest of Amateur Radio in jeopardy.

Ian Purdie
Toongabbie, NSW

Kits & servicing

May I offer a word of caution to readers intending to build electronic equipment from kits imported privately from the United Kingdom. Unless you are a competent electronics serviceman—don't! If things go wrong you may be left holding the sticky end.

Last year I ordered a kit for a stereo FM tuner from a supplier who advertises regularly in Wireless World.

It is now my misfortune that, after a period of working reasonably well, distortion became increasingly apparent and no amount of adjustment would put it right. The decoder no longer functions and my electronics experience does not enable me to fault-find on a board containing 3 IC's, 14 transistors and 63 resistors.

I am therefore left with about $95 worth of duty paid junk in the form of a Nelson-Jones FM tuner with varicap diode tuning and a Portus-Haywood phase-locked loop stereo decoder in non-working order, together with instructions and all relevant Wireless World reprints.

Perhaps an enterprising reader would care to make me an offer, since I intend to go and buy a cheap, inferior, but working Japanese tuner.

Ian R. Juniper
French's Forest, NSW

COMMENT: While modern integrated circuits and printed circuit boards make it possible for people with a very modest background in electronics to build up quite complex circuits, there is unfortunately no way at present of obviating the need for servicing skill if things go wrong!

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59 Meterless Voltmeter.
60 Wide Range Voltmeter.
61 F.E.T. D.C.
62 1966 V.T.V.M.
63 1968 Solid State V.O.M.
64 1973 Digital V.O.M. (1)
65 1973 Digital V.O.M. (2)
66 High Linearity A.C. Millivoltmeter.
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86 Reg 0-30VDC at 3A O/L Protected.
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94 "Q" Meter.
95 Laser Unit.
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97 Digital Freq Meter 70MHz.
98 IF Alignment Osc.
99 27MHz Field Strength Meter.
100 100KHz Crystal Cal.
101 1MHz Crystal Cal.
102 Solid State Dip Osc.
103 V.H.F. Dip Osc.
104 V.H.F. Powermatch.
105 V.H.F. F/S Detector.
106 S.W.R. Reflectometer.
107 R.F. Impedance Bridge.
108 Signal Injector.
109 1972 FET Dipper.
110 Digital Freq Meter.
111 Simple Logic Probe.
112 Frequency Counter & DVM Adaptor.
113 Improved Logic Probe.
114 Digital Logic Trainer.
115 Digital Scaler/Preamp.
116 Digital Pulser Probe.
117 Antenna Noise Bridge.
118 Solid State Signal Tracer.
119 1973 Signal Injector.
120 Silicon Diode Sweep Gen.

TRAIN CONTROL UNITS
124 Model Control 1967.
125 Model Control with Simulated Inertia.
126 Hi-Power unit 1968.
127 Power Supply Unit.
128 SCR-PUT Unit 1971.
129 SCR-PUT Unit with Simulated Inertia 1971.
130 Electronic Steam Whistle.
131 Electronic Chuffer.

TV INSTRUMENTS
134 Silicon Diode Sweep Gen.
135 Silicon Diode Noise Gen.
136 Transistor Pattern Gen.
137 TV Synch & Pattern Gen.
138 Cross Hatch & Bar-Gen

VOLTAGE CURRENT CONTROL UNITS
142 Auto Light Control.
143 Bright/Dim Unit 1971.
144 S.C.R. Speed Controller.
145 Fluorescent Light Dimmer.
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147 Vari-Light 1973.
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163 240 Communications RX.
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167 Fremodyne 4-1970.
R.F. Section Only.
168 110 Communications RX.
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171 Radio Control Line RX.
172 Deltahet MK2 Solid State Communications RX.
173 Interstate 1 Transistor. Receiver.
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200 PM 132-1971.
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202 ETI-425 Complete System.
203 ETI-416 Amp.
204 PM 136 Amp 1972.
205 PM 137 Amp 1973.
205A PM 143.

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210 E/T 100 100W.
211 P/M 134 21W.
212 P/M 138 20W.
213 Modular 200W.
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216 Fuzz Box.
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233 P/M 123
234 P/M 138
235 Simple B/C
236 PM 146 AM-FM

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239 FET Mono.
240 Dynamic Mic Mono.
241 Dynamic Mic Stereo.
242 P/M 115 Stereo.
243 —

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246 —
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255 Flasher Unit.
256 Lie Detector.
257 Metal Locator.
258 Stroboscope Unit.
259 Electronic Canary.
260 240V Lamp Flasher.
261 Electronic Siren.
262 Probe Capacitance Meter.
263 Moisture Alarm.
264 AC Line Filter.
265 Proximity Switch.
266 Silicon Probe Electronic Thermometer.
267 Transistor/FET Tester.
268 Touch Alarm.
269 Intercom Unit.
270 Light Operated Switch.
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272 Capacitance Leakage.
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287 Door Monitor.
288 Earth "R" Meter.
289 Shorted Turns Tester.
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Books & Literature

Not recommended

UNDERSTANDING ELECTRONIC COMPONENTS by Ian R. Sinclair. Published 1972 by Fountain Press, London. Hard covers, 218 pages, 215mm x 130mm, illustrated by drawings and half-tones. Price in Australia $10.50.

This is a companion book to "Understanding Electronic Circuits" by the same author, who is currently associated with the Braintree College of Further Education. Like the companion volume, this one is intended for students or readers who have a knowledge of electronics but who are seeking a deeper understanding of the subject.

The chapter headings are as follow: Introduction — Resistors — Capacitors — Inductors — Networks I — Networks II — Valves — Electronic Displays — Semiconductors I — Semiconductors II — Electromechanical Components.

Having just recently reviewed Ian Sinclair's "Electronic Circuits" more or less favourably, I was fully expecting a similar reaction to this one but it didn't turn out that way.

In sample reading, I came across an explanation (p 41) of why capacitors should not dissipate power; to my mind, it was not adequate. On page 51, the reader is likely to be left with the impression that a non-polarised electrolytic is essentially one using tantalum foil. On page 61 the author makes an exaggerated point that a centre-tapped transformer does not shift phase . . . it inverts the signal. On page 66 the reader is told that a gap is always provided in the core of large inductors. I had similar misgivings about series and parallel resonance (p 91), tuned lines (p 97), valve bias (p 109) and a statement on p 114 that Miller effect causes oscillation "instead of amplification".

In all these cases, and others which I could mention, the informed reader could see what the author was getting at, but it was compromised by ambiguities arising from brevity, ill-chosen phrases, inappropriate sentence construction and a suspicion on part of this reviewer that Ian Sinclair is more at home with the generalities of circuits than the particulars of components.

What he says in the preface is quite true, of course: there is a limit to how much one can say about components in a book of a given size. But I am firmly of the opinion that a critical, independant reading of the manuscript prior to publication could have pin-pointed its weaknesses. As it now stands, I would not be happy to recommend it.

The review copy came from Thomas C. Lothian Pty Ltd, 4-12 Tattersall's Lane, Melbourne 3000. (W.N.W.)

Children & TV

TELEVISION'S CHILDREN, by Kevin Tindall and David Reid. Published by the Audio-Visual Centre, Sydney Teachers College, 1975. Soft covers, 175 x 250mm, 72pp, with line drawings and diagrams. Price $2.20 including postage.

This is the first of a planned series of research reports to be published by the Audio-Visual Research Centre of the Sydney Teachers College. Subsequent titles will report on TV and violence, educational TV, children's TV, TV and social change, parents and TV, and TV and achievement.

The authors of the present report are Kevin Tindall, the Director of the

Research Centre, and Lecturer David Reid.

They appear to have planned this first work as a preliminary introduction to the broad field of research into the complex relationship between TV and children. In this sense it perhaps sets the stage for the later titles, or at least maps out the areas which are planned for further investigation.

The book is divided into two main parts. In the first section, the authors give some basic facts about children's viewing habits, and discuss the various implications of these facts. They also draw attention to those aspects of the child-TV relationship about which parents, authorities and others have expressed concern.

The second section presents data and analysis of two TV viewing surveys conducted in the Sydney viewing area, in September 1974 and May 1975.

This subject is one which I find of special interest, as readers are probably aware. Not merely because I am a parent of young children, but also because I have a reasonable background in both the theory and practice (I was tempted to type "mal practice") of both electronic communication and education. But even if I did not have this prior interest, I believe I would still have found the book absorbing reading.

Did you realise, for example, that by the time the average young child of today leaves school at age 16, they will have been exposed to about 17,500 hours of TV compared with only about 15,000 hours in the classroom? It makes you think . . .

All in all the book presents a good deal of very interesting and thought-provoking material like this, and I believe it will be of value to anyone who is interested in the influence of TV upon child development.

If you're a concerned parent, it should be almost compulsive reading. The more so because it is written in quite readable prose, not weighty ivory-tower stuff.

Copies are available at the price given above from the Sydney Teachers College, PO Box 63, Camperdown NSW 2050. (J.R.)

Standards history

THE INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES, 1875-1975. Published by the US Department of Commerce National Bureau of Standards, 1975. Soft covers, 145 x 230mm, 248pp, many illustrations. Price in US $3.00

Those who are interested in the development of our present international system of weights and measures — including those used in electronics — should find this NBS translation of the BIPM centenary volume of great interest.

Called NBS Special Publication 420, it is available from the Superintendent of Documents, US Government Printing Office, Washington D.C. 20402.

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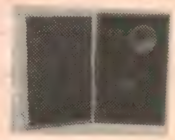

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The Amateur Bands

by Pierce Healy, VK2APQ

Amateur satellite report

The amateur satellite program has entered its eighth year of operation. Past achievements, if reinforced by a greater use of the satellite facilities, could favourably influence deliberations on amateur frequency allocations at the 1979 ITU WARC.

The need to publicise amateur contributions through satellite experiments is the theme of the December 1975 AMSAT—Newsletter editorial. It points out that the use of VHF and UHF by amateurs could be questioned at the 1979 World Administrative Radio Conference by countries who are not sympathetic towards the amateur service.

Some of the achievements and firsts in amateur satellite communication have already been featured in these notes. Currently, the facilities of two amateur satellites are being used as educational devices by schools, colleges and universities in Europe and America. Experiments are also being carried out in the transmission of medical data; e.g., electrocardiogram (ECG) signals. Acceptable ECG patterns, closely resembling the original, have been received.

Here are further notes on current and future AMSAT activities.

October 15th, 1975 marked the third birthday of AMSAT-OSCAR VI, outliving its lifetime goal by 300%. The spacecraft continues to operate well, although it is occasionally necessary to reduce the operating schedule as the solar panels gradually degrade with time. AMSAT-OSCAR VI should continue to operate far into the future, providing that telecommand operators are able to maintain regular control over the spacecraft.

AMSAT-OSCAR VII had its first birthday on the 15th November, 1975, and continues to perform well. Like most satellites of comparable complexity, it exhibits some anomolies such as occasional mysterious "mode-jumping", but none which seriously jeopardise the mission objectives.

During 1975, new AMSAT-OSCAR VI telecommand stations were put into operation at the University of Surrey, England, the Technical University of Budapest, Hungary and in California, USA.

In March, 1975, an international AMSAT conference was held, attended by representatives of AMSAT-Canada, AMSAT-Deutchland, Project Australis, AMSAT and the San Berardino Microwave society. The purpose was to define the AMSAT phase III next generation spacecraft. Phase III spacecraft are intended for high altitude, near synchronous or synchronous-transfer orbits, where communication time and range are much greater than with low orbiting satellites. (A report on that meeting was given in July, 1975, issue of these notes.)

Progress continued on the design and breadboarding of the phase III spacecraft. Plans are for it to carry two transponders, one using 145.9MHz for the uplink and 435.1MHz for the downlink, the other using 435.1MHz for the uplink and 145.9MHz for the downlink. The two transponders would operate alternatively according to a prearranged schedule, much as is done with the two transponders aboard AMSAT-OSCAR VII. The phase III spacecraft will also contain a microprocessor (already developed) which will function as a command decoder, telemetry encoder (providing Morse code, teletype, or any other code programmed into it), and provide experiment control functions as well.

The preferred orbit is a highly elliptical, high inclination one having an apogee of about 39,000kM (24,000 miles), with an inclination of 100 degrees. Such an orbit gives better coverage of the higher latitudes than does a geostationary one, and can be achieved by using an onboard apogee kick motor.

AMSAT-Deutchland in Marburg, Germany, is responsible for the overall phase III spacecraft design and breadboarding, while AMSAT-Canada in Ottawa and Montreal is responsible for prototype and flight spacecraft fabrication. Project Australis will assist in developing ground system equipment, and AMSAT-Washington will arrange testing and launch preparations. The total cost is estimated at between $100,000 and $120,000 (US). (This is met from donations, membership fees and the ARRL Foundation.)

In addition to the spacecraft, portable AMSAT satellite terminal equipment is being packaged for use in demonstrations and disaster areas. The terminals are battery operated, and capable of SSB operation with all transponders in OSCAR VI and VII as well as the phase III spacecraft to follow.

In addition to phase III, future projects are being planned. The Japan AMSAT Association is developing a four-watt, two-metre-to-70cm linear transponder which employs state-of-the-art RF power MOSFET techniques. AMSAT-Canada are repackaging the AMSAT-OSCAR VI and VII two-to-ten metre transponder to use thick-film hybrid printed circuit techniques instead of hand wiring. In the United States, a multichannel analog telemetry system is under development, and in England, AMSAT-UK members are discussing a possible fifteen-to-ten metre transponder project.

Reference orbits and operating schedules are:

AMSAT-OSCAR VI—
Period = 114.9946076 minutes.
Increment = 28.7486519 deg/orbit.
Inclination = 101.6015 degrees.

Operating schedule:
2/10 metres on (GNT days), ascending nodes; Monday, Thursday, Saturday, descending nodes; Sunday (Even days, educational demonstrations only).

AMSAT-OSCAR VII—
Period = 114.944834 minutes.
Increment = 28.736208 deg/orbit.
Inclination = 101.7010 degrees.

Operating schedule:
Even days of year, mode B.
Odd days of year, mode A.
Wednesday, experimental and bulletin use only. General communications not permitted.

Transponder frequencies:

AMSAT-OSCAR VI—
Uplink—145.90-146.00MHz.
Downlink—29.45-29.55MHz.
Beacon—29.45MHz.

AMSAT-OSCAR VII—
Mode A uplink—145.85-145.95MHz.
Mode A downlink—29.40-29.50MHz.
Mode A beacon—29.45MHz.
Mode B uplink—432.125-43.175MHz.
Mode B downlink—145.975-145.925MHz.
Mode B beacon—145.972MHz.
Mode A/D beacon—435.10MHz.

At the end of February, 1976, AMSAT-OSCAR VI will have completed 15430 orbits of the earth, and AMSAT-OSCAR VII 5910 orbits.

The board of directors of AMSAT are:—
P. Klein, K3JTE, president; J. King, W3GEY, vice-president engineering; T. Clark, W3LND, executive vice-president; W. Tynan, W3KMV; W. Dunkerley, WA2INB; L. Kayser, VE3QB; C. Dorian, W3JPT. Other officers include R. Carpenter, W30TC, secretary; R. Rosner, WB4UOX, treasurer; W. Hook, W3QBC, asst.-treasurer; Gary Tater, W3HUC, asst.-secretary; R. Zwirko, K1HTV, operations v-president; E. Clammer, W3UN, communication manager; J. Kasser, G3ZCZ, publicity.

New satellite operating award: The purpose of the award is to stimulate a continuing interest in satellite communications by providing recognition of QSO accomplishments, and to provide recognition by AMSAT of special efforts and services by all radio amateurs.

The basic award is available for confirmed satellite contacts with either (1) 20 US states, Canadian call areas, other countries, or a mixture thereof, or (2) six Australian call areas and two countries, or (3) any other requirements as specified by the AMSAT board of directors.

All contacts made via any OSCAR spacecraft using legal transmission mode are valid.

QSL cards or other written confirmation of contacts must show that the QSO was via a satellite.

In lieu of such QSL cards, applicants may submit a list of contacts confirmed by the awards manager of their national amateur radio society or AMSAT affiliate organisation.

All contacts must be made from the same QTH.

Sufficient postage must be supplied for the return of QSL cards sent. The award is free to AMSAT members, and is available to non-members for the nominal fee of $1.00(US). Please include your membership number.

Endorsements are available for each ten additional areas as defined in section (1) above.

Send applications to AMSAT-Award Program, Box 27, Washington, D.C. 20044, USA.

ORBITAL DATA—In co-operation with AMSAT, an orbital data calendar has been published by Skip Reymann, W6PAJ. The calendar contains all orbits for 1976 for both AMSAT-OSCAR VI and AMSAT-OSCAR VII. Also included is information on the operating schedules and frequencies for both spacecraft, the telemetry decoding equations, plus a step by step instruction on how to determine pass times of the two satellites.

The orbital calendar is available postpaid for $3.00(US) or 20 IRC's. Overseas orders will be sent airmail. Orders and payment should be made to: Skip Reymann, W6PAJ, PO Box 374, San Dimas, California 91773 USA. All excess receipts over costs benefit AMSAT.

AMSAT membership: Applications for membership should be made to Radio Amateur Satellite Corp. PO Box 27, Washington, D.C. 20044, USA.

There are four types of membership: Individual member—$10.00(US) per year. Member society—$20.00(US) per year. Life membership—donation of $100.00(US) or more. Life member society—donation of $200.00(US) or more.

Remittance should be made payable to AMSAT in US currency.

All members will receive the quarterly AMSAT Newsletter, and an AMSAT-OSCAR satellite pin for life members.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

AMATEUR BANDS

AMATEUR RADIO IN JAPAN

In mid 1975 there were over 286,000 amateur station licences issued in Japan, and the annual growth rate is between 10-20%. The licensing system in Japan provides for an operator's licence as well as the station licence. The total number of operator licences was just short of 500,000. All licences are issued for life and are not nulified if the holder upgrades to the next class. This means that it is possible to hold as many as four licences.

The four classes of licence issued in Japan are:—
First class:— Requires a theory test, Morse code test at 12wpm, Japanese Morse test. Entitles holder to all amateur privileges. Total licences 4,800.
Second class:— Theory test, Morse code test at 9wpm. All amateur privileges but limited to 100 watts antenna power. Total licences 20,100.

Radiotelegraph class:— Theory test, Morse code test of 5wpm. Operation on all amateur bands (except 14MHz), CW only. Antenna power limited to 10 watts. Total licences 437,600.

Radiotelephone class:— Theory test. Operation on all amateur bands (except 14MHz), phone only. Antenna power limited to 10 watts. Total licences 499,300.

The Japanese radio law makes little distinction between amateur and other communication stations and presents quite a challenge to a prospective licensee.

The Japan Amateur Radio League conduct classroom training, divided between theory and regulations, for the radio telephone course and requires about 40 hours' tuition. Passes run at about 85%.

The Ministry of Communication conduct examinations for all amateur licences twice a year. However, in the case of the 10 watt licences, those who complete the JARL classroom training course and gain a pass of 60% or more at the final examination, receive their radiotelephone licence without taking the government test.

Before a station licence is issued the station must be inspected by a government inspector. However, in the case of a 10 watt station a sanctioning system allows the JARL to act as guarantor to the Ministry.

This large amateur population has brought many problems which include serious overcrowding on the 40, 6 and 2 metre bands. More serious is the flaunting of the regulations, complicated by a lack of monitoring. There is no restrictions on the purchase of equipment, and there is frequent use of higher power than that authorised.

The JARL is aware of the many problems and established the Amateur Radio System Research Committee to study the situation and try to solve at least some of the problems. One proposal is a frequency allocation plan which has led to a wider use of VHF and UHF bands.

The use of HF bands by holders of no-code licences, as permitted by Japanese regulations, is based on their interpretation of the term "Harmful interference" in Article 3, section 3, paragraph 93 of the ITU Regulations.

AMATEUR RADIO AWARDS

Those interested in the various operating awards could find the Radio Society of Great Britain publication "Amateur Radio Awards" a useful reference book. In addition to full details of a large number of certificates, the book also contains countries lists, prefix maps and other useful data.

Available from RSGB publications (Sales), 35 Doughty Street, London WC1N 2AE, England. Price £1.69 ($2.75 Aus.). Airmail extra. Cheques and postal orders should be crossed and made payable to the Radio Society of Great Britain.

CANADIAN AWARDS: Amateur operators and short-wave listeners, worldwide, are invited to celebrate the XXI Olympiad to be held in Montreal, Canada, in 1976.

Two different and attractive awards will be issued to amateurs and short-wave listeners who fulfill the following conditions:—

World '76 Olympics Award: Work and/or hear amateur radio stations in any 50 countries which will compete at the 1976 Olympics in Montreal, Canada.

One contact must be with a Canadian station using an "XJ" or "XN" prefix. A special seal will be affixed for a contact with "CZ20", the official amateur radio station on the XXI Olympiad site.

Canadian 76 Olympics Award: Amateur stations have been authorised to use the prefix "XJ" in lieu of "VE" and "XN" in lieu of "VO" during the period 1st August, 1975 and 31st July, 1976. At least one contact must be made with each of the areas XJ1 to XJ8 and XN1 and XN2 for a total of ten contacts. Any contact with XJ0 (VE0) or the special Olympics amateur station will be allowed as a substitute for any missing call area prefix.

For either of these awards send certified log data list and 7 IRC's to:— VE3LSS, Radio Club, Listowel District Secondary School, Mr G. Hammond, 155 Maitland Avenue S., Listowel, Ontario, Canada N4W 2M4.

WIRELESS INSTITUTE NEWS

The WIA annual federal convention will be held in Melbourne on 7th to 9th May, 1976. Members wishing to submit agenda items or general business items should supply details to their divisional council.

It has been reported by the federal executive that discussions have taken place with the PMG's Department, putting the WIA views in regard to the 1979 ITU WARC. Assurance was given that the WIA would be brought into any discussion, on amateur radio by a preparatory committee formulating the Australian delegation's brief. The question of the accreditation of a WIA delegate, as was the case with the late John Moyle in 1959, is also receiving consideration.

RADIO CLUB NEWS

CENTRAL COAST AMATEUR RADIO CLUB: The Central Coast Award has been achieved by ZL2UK for having made two-way contact with the required number of stations in the Central Coast, defined as the Shires of Gosford and Wyong.

Meetings will be held in the club rooms Dandaloo Street, Kariong on 5th March—business meeting; 19th March—lecture night; 2nd April—election of officers. Visitors are welcome. For information write to the secretary, PO Box 238, Gosford NSW 2250.

GOLD COAST RADIO CLUB: For the second successive year the GCRC were host to the WIA Queensland Division annual convention. Approximately 200 amateurs and interested persons attended. Alderman Clem Jones of Brisbane officially opened proceedings and in doing so congratulated amateurs on the part they played in providing communications during natural disasters in Australia.

Several good lecturers were presented and all told the convention was a success.

The GCRC UHF repeater in operation. Input frequency is 433.1MHz and output on 434.3MHz.

For information on GCRC write to Secretary Mike Adams, VK4ZDA, PO Box 588, Southport, Qld. 4215.

SOUTH EAST RADIO GROUP: The SERG newsletter which seemed to have been delayed somewhere, contained notes which may still be of current interest. The call sign VK5BMG has been allocated to the club for use during the "Back to Mount Gambier" celebrations. Approval has been given by TV station SES8, for the SERG repeater to be installed at their transmitter site. Arrangements have been made with the South East College of Further Education for SERG meetings to be held in one of the class rooms.

If intending to visit or pass through Mt Gambier, contact the secretary, Box 1103, Mt Gambier, SA 5290, for information on SERG activities. You will be made welcome.

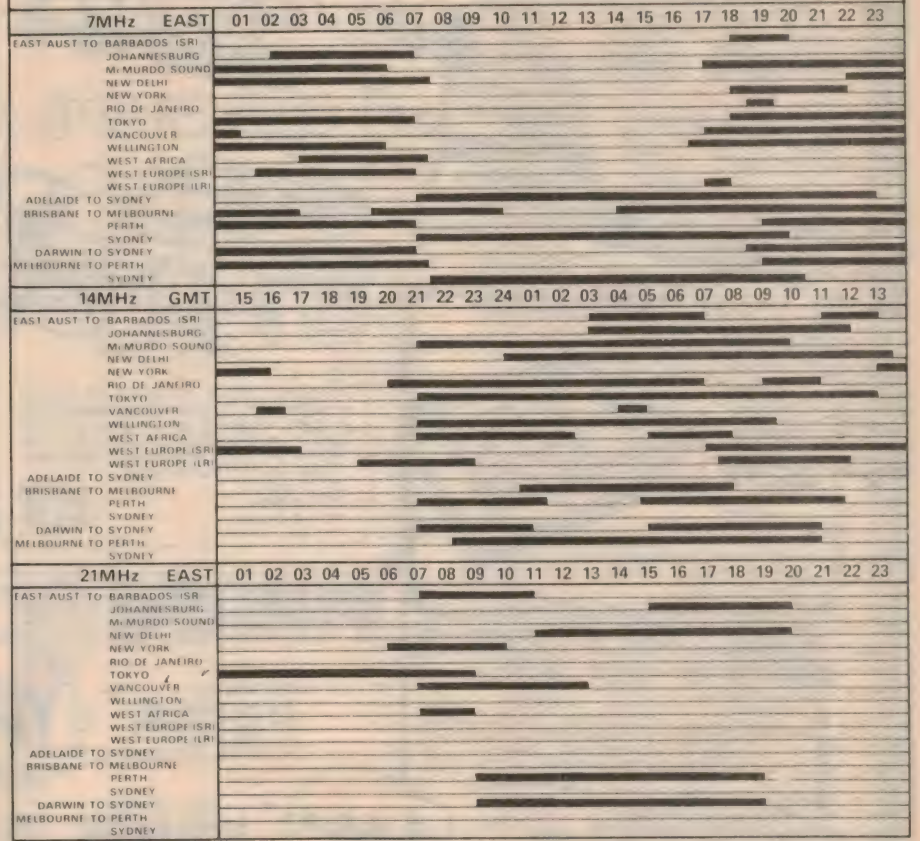
SYDNEY DX CLUB: Is holding a world popularity poll. To enter, list those you consider to be the top ten DX stations and in no more than thirty words state why the number one station was chosen. Entries must be in by the 30th April, 1976. Entry fee is a donation towards the Handicapped Aid Program.

For information about the club contact Adrian Pitt, president, PO Box 204, Roseville, NSW 2069, Australia. Send stamped, self addressed envelope for reply.

BOX HILL TECHNICAL COLLEGE RADIO CLUB: Here is a letter received from Mark Tredrea, a 5th form member of the club.

IONOSPHERIC PREDICTIONS FOR MARCH

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 3.76



"I have been asked to write to you about our school radio club and particularly our class activities.

"The students in the college radio club total 27. Fourteen are fourth form students and the remainder are fifth form and higher technician students.

"The course I am undertaking is fifth form electronics. This course was introduced this year as a preliminary year to the higher technician section. At the moment there are no amateur radio licensees in the class but several members are studying with the view of obtaining their licence at the end of the year.

"Our class has four hours of radio work per week, two hours' theory and the rest practical, except for the four hours' practical work sessions. We go on the air two hours per week, Wednesday 10 am to 12 noon. The club call sign is VK3BHT and operates on 80, 40, 20 and 2 metres.

"The ambitions of our class are varied—five hope to be telecommunication technicians, two radio technicians, two electricians, three electronic engineers, one scientific instrument maker and one physical education instructor.

"In the two hour practical sessions, the projects our class is undertaking include stereo amplifiers and electronic testing equipment; also repairing television sets, radios and electronic devices."

It is pleasing to receive such letters which indicate the enthusiasm of up and coming amateurs.

The club is supervised by Graeme Scott, VK3ZR, a member of the teaching staff at the college. More about the club and photographs in future notes.

ST. GEORGE AMATEUR RADIO CLUB: Seventy-five members and visitors were present at the November meeting of the SGARC. Many of the visitors were from neighbouring radio clubs.

Bill Shakespeare, VK2AGF, gave a down-to-earth resume on the practical aspects of antenna construction.

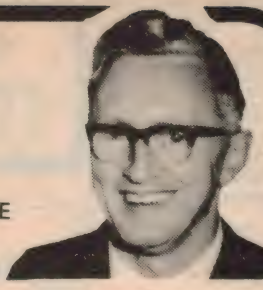
Meetings are held on the first Wednesday of each month in the Rockdale Civil Defence Headquarters Highgate Street, Bexley at 7.30pm. Visitors welcome.

INTERNATIONAL AMATEUR RADIO CLUB: At the annual general meeting held late in 1975 the following officers were elected; R. C. Kirby, WOLCT, president; E. Robinson, F8RU, and R. F. Stevens, vice-presidents; J. Rutkowski, secretary; L. Jarrett, HB9AMS, treasurer. R. Kirby is the director and J. Rutkowski a councillor of the International Radio Consultative Committee (CCIR) of the International Telecommunication Union.

New members of the IARC will be welcome, and a life membership is offered until the 1st July, 1976, for 50 Swiss francs ($15.00 Aus.). Membership applications should be sent to the Treasurer, IARC, Box 6, 1211 Geneva 20, Switzerland.

Shortwave Scene

by Arthur Cushen, MBE



The External Service of Radio Laos, broadcasting from Vientiane, has been heard with a service in English on 7145kHz at 1330GMT.

A new external service has been introduced by Radio Laos at Vientiane. The station is using the frequency of 7145kHz at 0400-0630GMT, 1100-1400GMT and 2300-0130GMT. The programs are in Thai, Vietnamese, Cambodian, French and English. The English broadcast is best received 1330-1400GMT on 7145kHz, and has been reported by John Mainland of Wellington, N.Z. Other transmissions are 0600-0630GMT and 0100-0130GMT.

According to the BBC Monitoring Service, the Domestic Service closes at 1430GMT and is broadcast on 640, 4245, 5160, 6130, 6200, 6210, 7310, 7480 and 8630kHz. In the past, Laos has been heard on 6130kHz and, according to the 'Down Under DX Bulletin', French has been observed 1230-1300GMT.

SIGNALS FROM UGANDA

Three frequencies have been heard carrying the new External Service of the Uganda Broadcasting Corporation from Kampala. Reception on 9515kHz has been noted 1600-1730GMT with a transmission to South Africa. English news is broadcast at 1700GMT followed by a commentary or economic talk, and at 1715GMT popular music. The station when closing at 1730GMT asked for reports to the External Service, Uganda Broadcasting Corporation, PO Box 2038, Kampala.

A second transmission 1800-1900GMT to West Africa is on 15325kHz. This frequency suffers interference from Radio Canada, according to John Mainland of Wellington.

The third transmission 1900-2100GMT is on 9730kHz, and has been heard with English announcements at 2030GMT.

SEOUL USES 7250kHz

Radio Korea, using the new frequency of 7250kHz, has been heard with English at 0900-0930GMT. This new frequency of 7250kHz from Seoul also carried Japanese at 0930GMT, but suffers from severe jamming at 1000GMT. Recently Radio Korea put into service three frequencies for its overseas services: 11850, 9600 and 9640kHz. The latter has long been the main channel for programs of the Korean Broadcasting System. The new outlet is not received as strongly as other frequencies, with 9640kHz still being the best signal for the English service, after the BBC leaves the same frequency at 0915GMT.

SANAA ON NEW FREQUENCIES

Radio Sanaa in Yemen has recently been heard on three frequencies during a period of testing for a new channel. John Mainland of Wellington, NZ, reports hearing the station on 7265kHz with an Arabic news bulletin at 0515GMT. Later the station was observed to use 9765kHz at the same time.

Our reception has been on the new frequency of 9780kHz, and transmissions were observed from 0300 to past 0600GMT. Reception is fair, but there is considerable sideband interference from the Voice of America on 9770kHz. The signals during the transmission around 1830GMT give better reception, and at this time a march, station identification and news in Arabic is presented. Signals suffer at this time from sideband interference from Radio Moscow on 9775kHz, which has been heard broadcasting in Portuguese. It is understood that the Sanaa transmission is from 1345-2200 GMT.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are in GMT. Add 8 hours for WEST, 10 hours for EAST, and 12 hours for NZT.

VERITAS CONTINUES TESTS

Test transmissions from Radio Veritas at Quezon City in the Philippines continue to be received. A broadcast 0100-0200GMT is carried on 15325kHz, with frequent announcements for reception reports. In addition, the station has also been heard on 15310kHz. According to the announcement another test transmission is broadcast 1400-1500GMT on 1187kHz.

Reports from listeners are requested to Radio Veritas Overseas, Box AC373, Quezon City, Philippines. Our reception of broadcasts on 15325kHz has shown good signals with sideband from Radio Australia on 15320kHz. This is also the case when Veritas is using the announced frequency of 15310kHz .

FREQUENCY CHANGES

Seasonal adjustments to frequencies are made by most international broadcasting stations four times each year, and on the first Sunday of this month, some minor changes will take place. Minor changes also take place on the first Sunday in September, with the major frequency changes occuring on the first Sundays in November and May. On these dates, the schedule valid for the following four months takes account of seasonal reception and several frequency changes are made.

As we are still at the low end of the sunspot cycle, there should be continued use of the lower frequencies, with emphasis on the 49, 41, 31 and 25 metre bands. During our summer, frequencies as high as 13 metres were used by many stations, with fair results. The rise in sunspot count in the near future should mean greater use of higher frequencies, thus spreading stations and resulting in less interference.

NEW COLOMBIAN

A new Colombian station which is a member of the Radio Super network has been noted on 6122kHz around 0700GMT. The station has frequent network announcements and carries a similar program to Radio Super Bogota on 6065kHz and Radio Super at Medellin on 5955kHz.

The frequency of 6122kHz enables fair reception up to 0730GMT, when there is sideband interference from Finland on 6120kHz. At 0800GMT there is severe interference from the Voice of America, which is using 6125kHz.

THAILAND'S NEW CHANNELS

Radio Bangkok has been heard on two new frequencies with their English broadcasts. Craig Tyson, Wembley, WA, has heard broadcasts at 0830GMT with an English announcement on 11950kHz which replaces 11905kHz.

Radio Thailand has also been noted on 9650kHz 1040-1140GMT with an English broadcast, according to Bill Vogel reporting in DX Post, Adelaide. This is a frequency change from 9655kHz. English is also broadcast on the new frequency 0415-0515GMT. The station is keen to receive reception reports on these frequencies.

MEDIUM-WAVE NEWS

GUAM: The Trans World Radio Station on Guam, KTWG on 770kHz with 10kW, has been heard in New Zealand around dusk with transcribed Gospel music.

Another new medium-wave station in Guam is KATB, which operates on 570kHz, and has been heard in Japan around 1720GMT. The address of this station is: PO Box 65, Agana, Guam 96910.

KUAM on Guam, one of the old established stations, has been heard closing at 1500GMT with the "Star Spangled Banner". Reception was mixed with the Japanese station JOLK on 610kHz.

GREECE: According to "Australian DXers Calling", and our own advice from the Voice of America, two stations, Kavala and Rhodes, have increased power from 150kW to 500kW. VOA Rhodes transmits on 1259kHz from 0300-2230GMT, while VOA Kavala transmits on 791kHz from 0200-2200GMT. Both stations can be heard around dawn.

LISTENING BRIEFS
EUROPE

POLAND: Radio Warsaw, using 7125kHz, has provided good reception at 1600GMT with a program in English. This includes a news bulletin, a press review, and other features.

HOLLAND: The 'Happy Station' program of Radio Nederland has been well received by E. L. Haynes of Northcote, Victoria on 15260kHz. The transmission, from 1400-1520GMT, is also carried on 11740, 15415 and 17810kHz.

GREECE: Athens Radio on 7140kHz opens in Greek at 0800GMT. The transmission 0800-0850GMT is beamed to the Azores and carried on the 100kW transmitter. Athens has also been heard on 9615kHz at 1400GMT in Greek by the BBC Monitoring Service, and this appears to be a new transmission.

AFRICA

ZAMBIA: Radio Zambia on 9580kHz has a news bulletin in English at 1600GMT, but reception is spoilt by a transmission from the BBC. The broadcast from London in Finnish also opens at 1600GMT, however it is possible to hear Radio Zambia broadcasting from Lusaka when conditions are favourable.

MALAWI: The Malawi Broadcasting Corporation is using 7130kHz for its broadcast from Blantyre and has been heard at 1615GMT. At this time local language programs are carried, but there is interference from Radio Moscow. At 1628GMT Deutsche Welle opens in Persian, making further reception impossible.

ASIA

MALAYSIA: Radio Malaysia at Kuching, Sarawak, in a verification gives the following schedule, according to "Australian Calling DX-ers". The station operates on 4950kHz with 10kW from 0800-1600 and 2200-0100GMT, 7160kHz with 10kW from 2330-1445GMT and 9605kHz with 10kW from 0330-0730GMT.

SRI LANKA: The broadcast of 'DX Monitors International', which is conducted by Adrian Peterson and broadcast over the Sri Lanka broadcasting Corporation, Colombo, is heard on Sundays around 0420GMT. In this area, reception is best on 15425kHz. However, this frequency is also used by the ABC in Perth, and consequently there is some interference.

AMERICAS

HONDURAS: Some months ago we reported the reception of a new station operating on 6185kHz with the slogan of "Radio Swan". The subsequent verification gave the location as San Pedro Sula and stated that the station broadcast 24 hours a day. The first Radio Swan was located on Swan Island in the Caribbean and broadcast programs to Cuba. Radio Swan has now made a frequency change, and has been heard on 6000kHz around 0700GMT. The address of the Station is: Apartado 882, San Pedro Sula, Honduras.

ARGENTINE: Signals on 6180kHz from Radio Nacional at Mendoza have been observed from around 0800GMT. This station formerly had the call sign "LRM" but is now known as "LRA34". Programs were typical Latin American music with station identification at 0845GMT.

SOUND ANALYSER
General Radio Co. Type 760A **$75.00**

MUIRHEAD
Decadade oscillator. Type DG 38A
$100.00

LANDING LIGHTS
24 volts. Ex R.A.A.F. **$9.50**

P.M.G. TYPE TELEPHONES
Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$35.00
(2 TELEPHONE SETS)

$1 cartage to rail. Freight payable at nearest attended railway station.

ALTIMETERS
Sensitive type ex Air Force, made by Pioneer USA. **$37.50.**
Post: A. $1.70, B. $2.25, C. $2.40, D. $2.65

TEN CHANNELS VHF TRANSCEIVER
Types TR 1934 100-125 MHz and TR 1936 125-150 MHz. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator. **$33.00**

MINIATURE ELECTRIC MOTORS
1½ to 3 volts DC. Ideal for model boats, cars, planes, etc. Strong torque. Only
75c each or 10 for $5
P & P 40c ea. or 10 for $1.10.

FREQUENCY METERS
AN URM 32 A 120 KHz to 1000 MHz, with two 40V power supply, **$125.00.** $1.00 cartage to rail, freight payable at nearest attended railway station.

ILFORD 17.5 mm SPROCKETED MAGNETIC TAPE
1000 ft reels brand new original packing **$4.00 ea.** quantity available
Post A. $1.30, B. $2.00, C. $2.30, D. $2.80

No. 62 TRANSCEIVER
With headphones, accessories etc.
$60

TELEPHONE WIRE
1 mile twin (2 miles) genuine ex-Army Don 8 perfect condition $35 per drum $1 cartage to rail freight payable at destination.

PRISMATIC COMPASSES
Genuine ex-army Mk 3, liquid damped, as new $45.00 P & P A. $1.70, B. $2.25, C. $2.40, D. $2.65.

MORSE KEY	MORSE KEY BUZZERS
$1.40 Post 40c.	**$4.25** Post 60c.

HALF INCH RECORDING TAPE
Top Grade 2400' on 10½" reels. Ideal Video Experimenting. Only **$3.50** per reel.
P & P A. $1.40, B. $2.25, C. $2.70, D. $3.45

UNI-SELECTORS
4 bank 25 position **$4** each.
P & P A. $1.40, B. $2.25, C. $2.70, D. $3.45

ADLER FREQUENCY METER
100KHz 20MHz **$95**

4 DIGIT RELAY COUNTERS
50 volt DC, suit slot car Lap counters, etc.
$1.25 each. P & P 60c.

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Cuts sheet metal like a punch and die, trims, notches and cuts to any size or shape over 7/16inch.
ONLY **$9.95**
Post $1.10

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1.2 Volt, fully charged, 4in x 3in x 1in 4 AH.
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Frequency Meters.
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Produces an Audio Signal in rich harmonics. Ideal for Sig Tracing in A.F., I.F., and R.F. circuits. Powered by 4 Penlight Batteries with On-Off Switch and indicator lamp. Size 1½" Diam. 5" Long. Only
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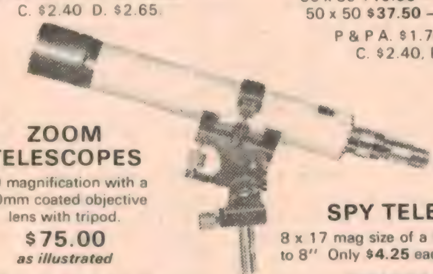
25 x 30 **$5.95**
40 x 40 With Tripod **$8.95**
60 x 60 With Tripod **$39.50**
30 x 60 Prismatic With Tripod **$34.50**
P & P A. $1.70, B. $2.25, C. $2.40, D. $2.65.



ZOOM TELESCOPES
60 magnification with a 60mm coated objective lens with tripod.
$75.00
as illustrated
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WALKIE TALKIES
2-way radio, 7 transistor PMG approved, set of 2 only **$48.50**

1 watt, 11 transistor **$130.00** set of 2.

P & P A. $1.80, B. $2.50, C. $2.80, D. $3.20

SMALL COMPUTER PANELS
3in x 2in containing 2 valves, qty. of resistors, etc.
ONLY **75c.** P & P 60c.

ELECTRONIC FREQUENCY COUNTER
Austronic type DFC-4 240V 50 cycle 0-100KHz **$150**

IMPELLER PUMPS
New gunmetal body, Stainless Steel Shaft. Neoprene Impeller. Up to 15ft. Lift, suitable for almost any type of liquid. Self prining. Ideal boat bilge pump, sullage drains, etc. Approx size 8" x 5"

⅜"	$23.30
½"	$31.95
¾"	$33.75

P & P A. $1.90, B. $2.75, C. $3.20, D. $3.95.

RECEIVER No. 210
2-16 M/cs **$65.**
Transmitter No. 11 suits 210 **$35.**
24 volt Power supply to suit above **$15.**
Or complete station with Headphones, Mic, Morse Key, Antenna **$110.**

SIGNAL GENERATOR
Palec Model SG1 150 Kc/s to 30 M/cs 240 VAC **$37.50.**
$1.00 cartage to rail.
Freight payable at nearest attended railway station.

522 Transceivers 100 150M CS
$35.00

5" CRO TUBE 5 BPI $5.50 each.
Post A. $1.40, B. $2.25, C. $2.70, D. $3.45.

POSTAGE KEY:
A: NSW.
B: Vic, Qld.
C: SA, NT, Tas, New Guinea,
D: WA.

VALVES
BRAND NEW IN CARTONS

807	$1.50	CV850	$1.50
65N7GT	95c	1H6G	75c
5U4G	95c	832	$5.00
EF50	75c	6X4	$2.25
5Y3	$2.25	VR64	75c
2 x 2	75c		

P & P 40c

PARABOLIC REFLECTORS PYREX MIRROR
36" dia. Ideal solar radio optical experimenting also decorating purposes. **$60.00.** Sorry shop sales only.

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30 x 30 **$19.95** — 45 x 40 **$28.95**
50 x 50 **$37.50** — 60 x 60
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8 x 17 mag size of a rifle cartridge extends to 8" Only **$4.25** each, post 60c.

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PRISMATIC Coated Lenses. Brand new. Complete with case.

7 x 35 Wide Angle	$35.50
8 x 40 Wide Angle	$39.50
7 x 50	$31.50
10 x 50	$32.50
12 x 50	$33.65
20 x 50	$37.95

P & P A. $1.80, B. $2.50, C. $2.20, D. $3.20

SOLENOIDS
Plunger Type 12V 300MA. Suit electric camera control, miniature trains, radio, etc.
$2.50 P & P 20c
200 MA 24 volt, ⅛in push movement.
$2.50 P & P 20c.

SELSYN MOTORS MAGSLIP
MK 11 .... $5.25 ea.
No. 19 TWO-WAY RADIOS.
Power supply, accessories, etc., **$35.**

3000 TYPE RELAYS
P.M.G. 200Ohms — 1'500Ohm
Coils **$2.50** each. P & P 60c.

P.M.G. TYPE KEY SWITCHES.
45c P & P 20c

Cintel Oscillator and Electronic Counter, type 388.
$250

SPECIAL lucky dip valve offer, 15 new valves in cartons for only **$2.95.** We haven't got time to sort them, so you reap the benefit.
P & P A. $1.80, B. $2.50, C. $2.80 D

RADAR TRANSCEIVER
X BAND WITH KLYSTRON ETC. **$45.00**

MULTIMETER
A compact and handy tester for workshop or lab where quick circuit checks are required
DC Voltage 5-2.5K (20,000 OHMS per volt) AC Voltage 10-1000V (10,000OHMS per volt) DC Current 0-50 UA. 0-2.5 MA, 0-250 MA. Resistance 0-6 Megohms Capacitance 100 UUF to 1UF. Decibels — 20 to plus 22 DB. Complete with instructions.
Only **$17.25** ea. Post $1.05.

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¼" x 2400' on 10½" reels **$4.95**
P & P A. $1.70, B. $2.25, C. $2.40, D. $2.65.

Panoramic Adaptor
E.M.I. type PRA-1 455 variable Kc
Course 440-520 Kc
Centre Freq 520-440 Kc
Fine Centre Freq 20-0-20
Filter band with 50, 100, 200 L.F.
200 H.F. Sweep band width 0-200.

$75.00.

CONDENSER LENS
1½" Diam 4½" F.L. **75c** 2½" Diam 2" F.L. **$1.50** each. Or **$2.50** per pair. P & P 40c

TRANSCEIVERS Ex Army
No 10 set, 38 to 55MHz with hand piece **$22.50.** Battery to suit **$3.50** extra.
No C42 set, 36 to 60 MHz complete with 24V power supply, headphone, mic, leads etc **$65.00.**
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$1.00 cartage to rail, freight payable at nearest attended railway station.

Hartley double beam oscilloscope. Type 13A with probes.
Working **$150.00**

77D x RCA STUDIO RIBBON MICROPHONES Variable pattern & response music or speech. $80.00 ea. Post A $3.30 B $4.00 C $4.30 D $4.80.

Director dumpy levels optical complete with tripod and carrying case ideal for all level work also gives elevation and depression illuminated only **$85.00**

ANTENNA MASTS
Telescopic. 10ft. extending to 27 ft. Complete with nylon rigging, stays pegs and base plate.
$45.00

15" SPEAKERS
Top grado high fidelity. Dual driver. 20 to 20,000 Hz. 120° dispersion. 15 OHMS 40 Watt rating.
$75.00

ANALYTICAL SCALES
Brand new. Griffin & George (London) Housed in timber & glass case 16" x 16" x 7". Weighs down to fractions of grams. (No weights supplied.) Usual price $187.50. Special **$45.00 ea.** Post A. $2.10, B. $3.25, C. $4.00, D. $5.25.

REPERFERATOR
Genuine Siemens Type 33c **$65.00**

Deitch Bros.
70 OXFORD STREET, SYDNEY 2010
SORRY NO C.O.D.

INFORMATION CENTRE

DIGITAL ALARM CLOCK: I have just read with interest the letter from R.J. of Melbourne, and your reply, in the December 1975 issue. I have just completed building the same project, and experienced the same problems as R.J. The temperature of my clock chip was high, and I found this to be due to excessive current being drawn by pin 23.

I added a 5k resistor in series with pin 23, and reduced the current drawn from 80mA to 2mA approximately. However, this increased Vss to 30V, so it was necessary to add a 1k resistor in series with D2. The components were soldered directly to the pattern on the underside of the board. (D.S., WA.)

• Thank you for your comments concerning the Digital Alarm Clock, D.S. We have investigated the problems you have outlined, and also your solutions, and in last month's issue we published a note detailing improvements which can be made to the clock.

TAPE DECK: I have recently bought a stereo reel-reel deck mechanism which I would like to use in conjunction with my Playmaster 144 cassette deck (File No 1/RA/31). The deck is unbranded, has 7in reel capacity, has 3¾, 7½ and 15ips tape speed, provision for a separate monitor head and is wired for 240VAC. The R/P head is stamped 250mH. My queries are: If I arrange suitable switching, could I use the record, replay and erase circuitry of the PM144? If the replay circuit is incompatible (I read your reply to G.B. of Glen Waverley in the September issue), would the tape head preamp described in September 1971 (1/PRE/26) be a suitable link to a Playmaster 136 tape socket? If neither of these alternatives is feasible, would you consider designing a circuit for readers who wish to build their own open-reel deck, if possible with tape-tape transfer to the PM144. (M.S., North Carlton, Vic.)

• Our answers to your questions are No, Yes and No. The Playmaster 144 circuitry is not suitable for open reel decks with high impedance heads. There is little demand for and little advantage in designing an open reel tape recorder. We have designed circuitry for these in the past, the most recent being a hybrid valve and transistor circuit, the Playmaster 119 Stereo Tape Adaptor, September 1967, File No 1/RA/28. Reprints are available from our Information Service at the usual charge of $2.00.

GAS DETECTOR: In the June 1974 issue of your magazine, you presented "An Electronic Gas Detector" (File No 3/MS/47). Mention was made in the article that if there was sufficient reader interest, a more complex circuit may be presented.

I now have need to make a similar gas detector, as presented, but with some additional features: it must have an audible/and/or visible alarm and the unit must be so wired that it will prevent the ignition of a boat from being switched on until the unit has ensured that petrol fumes have not been detected. While the latter requirement seems to present no large problems, the first-mentioned may be a little harder to arrange.

Do you have any plans for the inclusion in "Electronics Australia" of a more complex Gas Detector? (P.M., Beaudesert, Qld.)

• Your plans to build a Gas Detector in a boat do not seem to present any really difficult problems but unfortuntely we are not in a position to make practical suggestions. To date, we have had little feedback on the Gas Detector project and so we have no immediate plans to publish a more complex unit.

HIGH POWER AMPLIFIERS: With the apparent swing nowadays to amplifiers of preponderous power capabilities, I was wondering if you intend to describe a stereo hi-fi power amplifier of approximately 200-300 watts per channel. I for one would certainly be interested in it, since I have just invested in a new, but inefficient, speaker system, which means that half my modest 34 watt per channel amplifier is wasted, not to mention the other obvioius advantages of going into high power.

I'm sure that there are many readers like me who own a semi-professional pre-main amplifier with the facility to separate the same. It would, therefore, be relatively easy to simply "add-on" a more generously rated power amplifier to such a system. (R.D.D., Cal Gully, Vic.)

• We have no plans at present to describe an amplifier of the size you have quoted. Suitable transistors for use in the output stages of such amplifiers are almost impossible to obtain at economical prices, and so any plans for such amplifiers would have to wait until suitable devices become available.

CDI PRAISE: I for one will testify to the desirability of CDI on two stroke engines. Without having done any other servicing to my triple-cylinder, triple ignition coil and triple points motorcycle (which incidentally necessitated three trigger systems coupled to the converter unit) except simply fitting CDI, the results were (1) idling speed lowered from 1200 RPM to a steady 800 RPM (2) greatly enhanced throttle response thus improving acceleration and (3) more power than the bike has ever produced at over 6000 RPM.

I have ideas as to how I could design an automatic electronic ignition advance which is a real necessity for any high revving engine (and which very few motorcycles have) but my design would probably be too crude. So I'm waiting in anticipation for you to produce a project for an automatic electronic ignition advance unit to go with the CDI unit. While we're on the topic of CDI, a unit adaptable to lawn mowers would be useful. How about it? I realise that you might envisage some people ruining their engines but advancing ignition by about 35 degrees BTDC at 8000 RPM is

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

PRINTED BOARD PATTERNS: Dyeline transparencies, actual size but of limited contrast: $2. Specify positive or negative. We do not sell PC boards.

REPLIES BY POST: Limited to advice concerning projects published within the past 2 years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

BACK NUMBERS: Only as available. Within last 6 months, face value. 7-12 months, add 5c surcharge; 13 months or older, add 10c surcharge. Post and packing for 60c per issue extra.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee, for reply in the magazine, at the discretion of the Editor.

COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

playing reasonably safe. This is taking four strokes into account, for two strokes the advance would need to be slightly higher. (P.T., Canterbury, Vic.)

• Don't hold your breath, P.T. We would not envisage producing a project along these lines. The ramifications of reliability of the increased number of components and the likely problems in providing quick changeover from the existing system to the electronic and vice versa would greatly outweigh any theoretical advantage. Nor do we think a CDI unit for lawn mowers is really practical. It might give more reliable starting, but for a considerable increases in complexity. Don't forget, you'd need to fit a battery and a suitable charging system.

HIGH POWER AMPLIFIER: I must say how pleased I am with the Playmaster 128 Stereo Amplifier (Jan 1970) and its companion 127 Control Unit (Nov 1969) which I built some four years ago. Although both units continue to give sterling service, could some thought be given re updating circuitry? As you will be aware, commercially made high power amplifiers are currently enjoying a great deal of popularity and many enthusiasts wishing to build their own will favour the separate preamp/power amp approach. (T.S., Tatura, Vic.)

• It is gratifying to learn that your Playmaster 127/128 stereo system has given you such good performance. We agree that an updated version may prove a popular project, and will give due consideration to publishing an amplifier of similar power output to the Playmaster 128 in the near future. However, modern design trends now favour the integrated amplifier approach (i.e. power amplifier, preamplifiers and tone controls incorporated into one unit), and this will probably be our design philosophy for the present.

TAPE COPIER: I have been approached by a church group with the idea that I should help develop a copier which would make available cassettes of the service within about 15 minutes of the end of proceedings. They have mechanically inclined members who feel confident that they could modify up to a dozen standard Vortex decks to operate at a higher speed for copying. Where they need my help is with the electronics. Could you oblige with a circuit? (S.C., Maroubra, NSW.)

• The usual idea behind such a scheme is to allow churchgoers to take a tape of the service to shut-in parishioners. What is not always realised is that old and ailing folk often cannot cope with a purely audio event which typically lasts for an hour or more. A much more realistic approach is to record the service on a good quality open-reel machine, thereafter editing the tape down to a much shorter format by eliminating lengthy announcements, verses from long hymns, long voluntaries, etc. This involves expertise, a fair amount of somebody's time and, of course, a delay in producing the edited master tape, but the end result can be far more listenable. And, of course, it largely obviates the need for high speed copying, involving only the master and ordinary decks as "slave" copiers.

As far as high speed copying is concerned, there would be far more to it than merely speeding up a conventional deck. We doubt that the Vortex or any other ordinary deck could be adequately modified. High speed coping is normally done on to open reels of tape, which is then cut up and loaded into blank cassettes.

As far as the electronics is concerned, copying at say six times normal speed calls for six times the bandwidth and a proportionate increase in bias frequency. No ordinary heads would be equal to the task and very special amplifier, compensation and bias circuitry would be needed. There's a lot more to it than your group appears to imagine and we think that you would be wise to think it through again.

Marketplace

FOR SALE

BRAND NEW net C = 32 freq. counter in box with warranty & instructions. $450.00 or nearest offer. Phone Harden 868-201 after hours or write: Mr. Michael Stevenson, "Attunga", RMB 59, Harden, 2587, N.S.W.

TV MASTHEAD AMPLIFIER with power unit, 22dB gain, $32.00, P&P $3.00. Tweeters, 8 ohm, 80W $8.00, P&P $1.50. LED readouts, jumbo 1 inch $3.90; ⅜inch $1.80, P&P 30c. Transistors BC147, 148, 149, 157, 158, 159—10 for $1.80. AC127, 128, 187, 188—68c each. Diodes IN4004, IN4002, 10 for $1.50. BA222, 10 for 90c. 1MHz crystal $11.50, P&P 40c. Primo EMU522 Mics $19.80, P&P $2.00. Portable 12V fluorescent lantern with Cig. lighter extension lead, suitable for camping, etc., $13.00. P&P $2.00. Electronic Concern, Box 380, Darlinghurst, 2010, NSW.

PC LAMINATES TO CLEAR, 3½" x 24" x 1/16", single-sided phenolic, 1 oz copper. $2.50 for a pack of 5. $1.00 for P&P in N.S.W. Hobby Hire, 16 Coveney St., Bexley 2207. Tel 50 4361.

PLAY THREE EXCITING ELECTRONIC GAMES. Tennis, Football, Basketball. Just plug TELEPLAY Mk III into the aerial socket of your T.V.—B&W or Colour—and you are ready to play. Mains operated. $115. Reg. Post and Pack $5.50. Logic Leisure Electronics, Box 390, P.O., Mascot, N.S.W. 2020.

DISPLAYS: FNA37 9 digit calculator LED display $5.50; SP-425-09 9 digit Sperry Gas Discharge Display $3.50; POSITIVE VOLTAGE REGULATORS: 305 up to 40 volts TO-5 $2.00; 340 T series 5V, 6V, 12V, 15V & 24V volts (specify voltage wanted) TO-220 $2.25; 376 up to 40 volts mDIP $1.10. NEGATIVE VOLTAGE FOLLOWER: 304 up to —30 volts TO-5 $1.60. OPERATIONAL AMPLIFIERS: 301 TO-5 or mDIP 60c; 307 TO-5 or mDIP 90c; 709 TO-5 or DIP 75c; 741 TO-5 or mDIP 80c; 747 (dual 741) TO-5 or DIP $2.45; 748 (freq. adj) mDIP $1.25; 3900 Quad DIP 80c. VOLTAGE FOLLOWER 302 TO-5 $1.10. VOLTAGE COMPARATOR: 311 mDIP $1.50. CALCULATOR CHIP: 5005 12 DIG 4 func w/mem $5.95. DIGITAL CLOCK CHIPS MM5311 28 pin BCD 4 digit mux $8.95; MM5312 24 pin 1 pps BCD 4 digit mux $7.95; MM5314 24 pin 6 digit mux $8.95; MM5313 28 pin 1pps BCD 6 digit mux $8.95; MM5316 40 pin alarm 6 digit $9.95. All parts new & guaranteed; Data sheets supplied upon request with order. WORLDWIDE ELECTRONICS, P.O. Box 308, Hornsby, N.S.W. 2077.

BARGAIN PACK OF CLOSING DOWN STOCK—103 assorted valves, assorted capacitors, transformers, plugs and sockets and other items too numerous to list. All new, packed and marked. Write for detailed list. Real value at $420.00. Also 19 stylii and 4 cartridges for $30.50. All parts are fast moving. Peter Stocks Electrical, PO Box 229, Hughenden, Qld. 4821.

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WE SELL Construction Plans. TELEVISION 3D converter, $25 camera, Kinescoping recorder, VTR Colour Converter. HOBBYIST: Electronic Microscope, 96-hour music system, voice typewriter, Morse Code to typewriter copier, solid state Teletype. TELEPHONE: Answering machine, pushbutton dialler, phonevision, Autodialler, Car Telephone Extension, legal connector. BROADCAST: Special effects Gen., Time Base Corrector. Plans $7.50, air shipped from our USA research labs. COURSES: Telephone Engineering $52. Security Electronics $33. Investigative Electronics $29.50. Super Hobby Catalog plus 1 year's Electronic Newsletter, air mailed $1.00. Don Britton Enterprises, Suite 28, 280 Pitt St, Sydney, Australia.

TRANSFORMER BARGAINS—All 240V pri., r.m.s. values quoted 12V C.T. IA, $4.50; I8V 4A, $10.50; 25V C.T. I.2A, $7; 40V C.T. I.4A, $10; 70V C.T. I.7A, $15.50; plus many others. Send S.A.E. for catalog. Prices include postage. R.K.O. Electronics, 4 Shaw Street, Springvale South, Vic. 3172. Phone 546 6631.

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RESISTORS AND CAPACITORS Packs of 285 resistors. Standard Pack contains 5 each of E12 values 10 ohm to 470K in I.R.H. GL ½ metal glaze resistors, (½ watt at 70°C. 5%) Computer Pack contains selected quantities, All values included. $7 per pack. Individual resistors 3c each, 250 or more 2.5c each. Each value is individually packed so no sorting out required! Phillips ¼ watt carbon film still available, see E.A. November. CAPACITORS. Ceramic 50 volt circular plate. 10, 25, 47, 68, 120, 270, 470, 680 pf and .001 mf 5c each. .0022 .0033 .0047 .01 .02 .047 8c each. .1 mf 9c each. Ceramic pack contains 80 capacitors being 5 each of values listed. Due to high demand reduced to $4.50 per pack. Polyester "Green Cap" 100 volt .001 .0022 .0033 .0047 .01 7c each. .022 .033 .047 .068 mf 10c each. .1 and .22 13c each. Polyester pack contains 5 each of these values for $5.00. ELECTROLYTICS, Uprights 1000, 16 volts, 40c, 35 volts, 70c, 2200 mf 16 volts, 55c, Pigtails 1000 10 volts, 35c, 1000 35 volts, 80c 2200 mf 16 volts, 80c, 2200 35 volts $1.20. Transistors BC549 6 for $1.00 or 18c each. BC557 6 for $1.00 or 18c each. Diodes IN914A 10 for $1.00 12c each. All components brand new from manufacturers or agents. Each value of component individually packed. Post and packing included in all orders over $6.50. For orders less than $6.50 add 40 cents for post and packing. 5% discount on orders over $35.00, 10% discount on orders over $75.00. Send orders to RAM ELECTRONICS, 575 SYDNEY ROAD, SEAFORTH, N.S.W. 2092. Please enclose cheque or money order.

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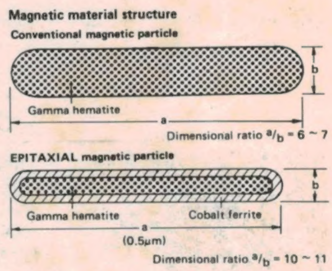
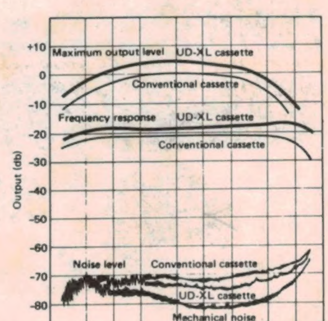
Advertising Index

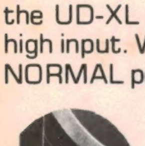
Introducing the revolutionary UD-XL EPITAXIAL cassette

Developed by MAXELL this completely new EPITAXIAL magnetic material combines the advantages of the two materials (gamma-hematite and cobalt-ferrite): the high sensitivity and reliable output of the gamma-hematite in the low and mid-frequency ranges and the excellent performance of the cobalt-ferrite in the high-frequency range. The result is excellent high-frequency response plus wide dynamic range over the entire audio frequency spectrum.

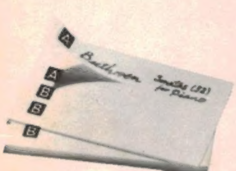


Compared to chrome tape, sensitivity has been improved by more than 3.5dB. Because EPITAXIAL is non-abrasive, it extends to the life of the head. Consequently, the UD-XL delivers smooth, distortion-free performance during live recording with high input. When using UD-XL it is recommended that tape selector be in the NORMAL position.





Fidelity is also ensured by a precision-manufactured cassette shell with a special anti-jamming rib that provides smooth tape travel and helps eliminate wow and flutter.



Another good idea of the UD-XL cassette is a replaceable self-index label. Simply peel off the old label and put on a new one when you change the recording contents. No more mess on the label.

maxell®

For further information please write to Maxell Advisory Service, P.O. Box 49, Kensington, N.S.W. 2033.

WT.GD. 76M

TOP DECK.

1669

1668

1667

1655

Whichever cassette deck you finally adopt from the JVC range, you can't lose. All have been designed with the sound connoisseur in mind.

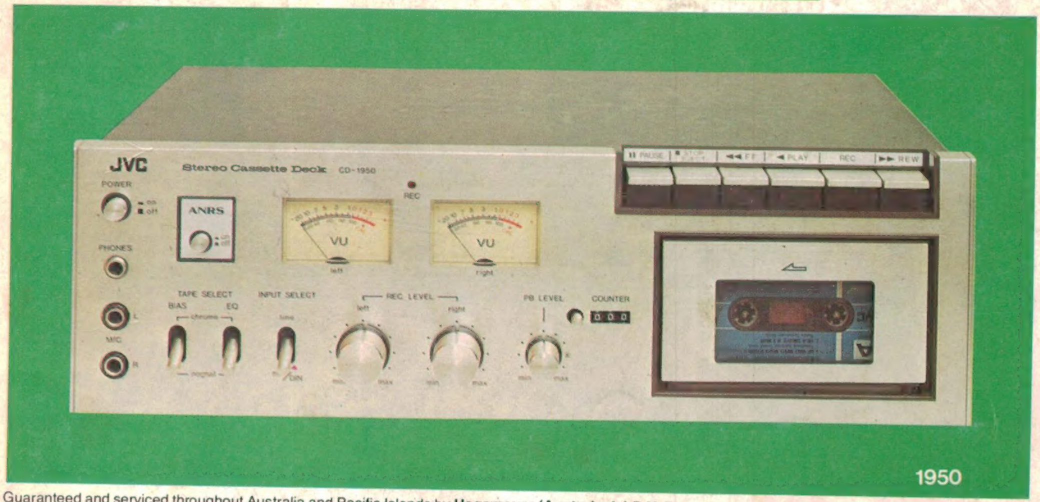
If, however, money is no object and you won't settle for less than one of the best, then may we recommend the 1669 and 1950.

1669 — ANRS — JVC exclusive noise reduction system, separate motors driving the capstan and reels, feather-light operation with servo assisted controls, memory counter with automatic restart.

1950 — Once again ANRS — JVC exclusive noise reduction system, cronious head for greater fidelity and life, independent drive mechanism, plus all the controls built up front.

These are just some of the features that make these one of the best.

But whatever you're prepared to pay, with JVC you can be sure your money is on the top deck.



1950

JVC

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